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The Montreal Convention. THE ELECTRICAL WORLD takes pleasure in extending congratulations to the National Electric Light Association on the occasion of its Montreal meeting. So cordial an invitation was extended by our Canadian friends at our last convention that a trip to Montreal at this time was a foregone conclusion. Every possible courtesy has been extended both to visitors and to the exhibitors, with the result of bringing together an electrical display such as has never been found at a similar gathering. Not only is the selection of Montreal as a place of meeting a happy one as regards the facilities and courtesies that have been extended, but it augurs a closer union of the electrical interests of the United States with those of the Dominion, and should do not a little to stimulate friendly intercourse and the growth of electrical industry. If the prosperity of a particular line of business may be judged by that of its representative journal, the current issue of THE ELECTRICAL WORLD, with its 60 pages of advertising, is evidence enough of a bright outlook.

From Niagara to Chicago. OUR cable dispatch this week gives some further details regarding the success of the long distance transmission of power from Lauffen to Frankfort. The work has been well and efficiently done even over so great a distance, and it is certainly pertinent to inquire how long American engineers propose to keep in the background as regards long distance power plants, for in the background we certainly are just at the present time. The Lauffen-Frankfort plant aside, there is the Ferranti station in London, where very high voltages are used, there are several long distance installations in Switzerland, and our issue of August 22d contained a list of the machines now building at the Oerlikon Works for the transmission of power over distances varying from 6 to 15 miles. The annihilation of space by electrical means is as yet in its infancy. The water powers of our mountains are unutilized. There is every opportunity to open an immense field of industry if our engineers will but take hold of the work and push it forward. If at the time of the Chicago exhibition we could point to the power of Niagara conveyed to the exhibition grounds and utilized to the utmost capacity of the plant, even should it be only one or two hundred horse power, a stimulus would be given to long distance work that would lead to results of almost inestimable value. Five hundred miles, in view of the successful installation at Frankfort, is not a prohibitory distance by any means; on the contrary, more than one skilled engineer has expressed to us his entire willingness to undertake the work and guarantee its success. A little enterprise on the part of some one of the large companies would give an impetus to the work and incidentally to its own prosperity that would produce prodigious results. The plan is entirely practical and it ought not to be a difficult matter to awaken a public interest in the subject that would secure hearty co-operation on the part of those who could be of assistance in carrying on the work. Once installed the plant might well be put to permanent practical use, if not over the whole distance at least over a considerable portion of it. Aside from its indirect value, therefore, the enterprise might, and probably would, have a commercial future in itself.

The Electrical Census. A SHORT time ago we gave a brief report concerning the elaborate electrical census to be carried out in the State of New York. Such a work is really of great importance, and ought to be extended over the whole country. A short note in one of the daily papers a week or two ago estimated the investment in electrical industries in this country as amounting to very nearly one billion dollars. Surely interests of such colossal size should not be lightly passed by, especially since they have had their origin, and have grown to their present magnitude, within the decade that has passed since the last census. A strong effort should be made to have the exact enumeration proposed for New York generally carried out, for the mass of information thus gathered would be invaluable. Not only would the direct effects on those most immediately concerned be excellent, but the indirect results would soon be perceptible in increased popular confidence and respect. Now, when the National Electric Light Association is about to meet, is certainly an appropriate time for again agitating the question, and possibly for taking active steps toward securing complete representation for the great electrical industries.

Combination Stations. WHY is it that we so seldom see central stations equipped with apparatus for doing all kinds of work? Nothing is commoner than to see a station provided only with low tension machines when it might just as well be doing in addition a profitable arc lighting business. Or, on the other hand, we find a station devoted exclusively to arc lamps, leaving the whole field of incandescent lighting untouched, to be occupied by some other company, or, possibly, not occupied at all. Sometimes the arc light circuit may stretch over miles of country, and the incandescent work may be attacked with two or three low tension machines operating over a 1,000-foot radius from the station, when a little enterprise and an alternator or two would enable the service of the company to be very profitably extended into the residence district. It is very seldom indeed that one sees the ideal state of things illustrated, where the service near the station is carried on by direct current incandescent lighting, in the outlying districts by the alternating current, and arc light circuits ramify through the whole region. Such an arrangement has more than once been shown to be very advantagous in point of economy, and yet how few managers of direct current stations have the nerve to put in an alternator for distant work; or, on the contrary, when operating alternating stations over a wide stretch of country to use direct currents for the near by service. And this, in spite of the fact that both proceedings would often add to the profits of the station. Of course this state of things is due in part to the position taken by the large companies in viciously opposing the use of any other apparatus than their own, and oftentimes pinching in any convenient way the local organization that would have the temerity to equip its plant for its own interests rather than for the glory and profit of the ——— system. It is likely that as time goes on we shall see more and more independence shown by station managers, who must realize that they are neither in business for their health nor for the purpose of purchasing apparatus. The time has long gone by when rational men can be convinced that there is any one make of apparatus that is infinitely superior to all of its competitors at any price: experience has taught that no machines are without their faults and none have a corner on all the electrical virtues. A little independence based on this knowledge will oftentimes save considerable money, and as time goes on we hope to see more and more striking evidence of it.

Breaking the Record. EVEN the Weems lightning express and the much-exploited Portelectric system must look out for their laurels, for the locomotive has recently been letting itself out at a rate little short of appalling. August 27th made some new and phenomenal records in high speed railroading. The place was on the Bound Brook line between Neshamany Falls and Langhorne, N. J., and the time—well, the time was enough to make the ghost of Stephenson throw up its hat. The feat was accomplished by engine No. 206, drawing a train of three cars, two ordinary passenger coaches and a heavy private car. The engine in question had five feet eight inch driving wheels and is of the Wootten model, burning anthracite coal. In passing it may be said that the Wootten locomotive is characterized by a much greater width of furnace and far larger grate area than the standard boiler; the firebox is extremely capacious, reaching far to the rear of the engine, so that the cab is on either side of the waist of the boiler immediately in front of the furnace. With this type of boiler remarkable results have been achieved, principally owing to the large grate area and the relatively less depth of fuel used thereon, allowing free combustion. Tests made with an engine of this pattern have shown an increased efficiency of combustion, and hence a greater steam capacity, of nearly 20 per cent. A single mile was made in 39¾ seconds, while 10 consecutive miles were made at an average speed of 43 seconds per mile. This establishes a new record for the locomotive, the mile being run at the rate of 90.45 miles per hour, between two and three miles faster than the best previous record. The 10-mile run was equivalent to 83.72 miles per hour. We call special attention to these extraordinary figures by way of emphasizing a remark that we have more than once made, that the locomotive is, all things considered, a most remarkably serviceable and efficient machine. Well may the electric motor look to its laurels with a record like this to confront it. Nevertheless such an unparalleled feat of railroading really helps the motor more than it hurts it, for in the first place it puts beyond question the possibility and practicability of laying tracks good enough to permit of extraordinary speeds, without an inordinate expense. Although the locomotive is capable on occasion of such work as this, it would be very difficult to secure a continued performance at anything like the same rate, owing to the necessity of frequent firing and the great amount of fuel and water that has to be carried to sustain such an effort. The electric motor at 90 or 100 miles an hour would have enormously less difficulty in keeping up speed than a locomotive, to say nothing of the probable gain in running expenses.

The Rise of the Incandescent Lamp. WE publish in this issue a rather extended paper by Dr. Böhm dealing with the progress in the art of incandescent lighting. The author was in the Edison laboratory during the experimental stages of electric lighting, and in fact himself assisted in the manufacture of many of the early Edison lamps. His review of the successive steps taken in the development of the glow lamp is decidedly interesting. A good many points are raised that from an historical standpoint are decidedly instructive; first among these may be mentioned the fact that the Edison platinum lamps were made exactly after the method employed in the manufacture of Crookes' often discussed radiometers, by one who had been familiar with their manufacture and who simply applied it in the Edison laboratory. The all glass closed exhausted chamber with its platinum leading-in wires and incandescent conductor within was made in the Edison experiments confessedly directly after the pattern of Crookes' radiometer, and by Dr. Böhm himself, who had been a pupil of Geissler and was familiar with the manufacture of such delicate glass apparatus. Subsequently the carbon lamps were fashioned in the same way. But perhaps the most interesting portion of the discussion is that relating to the structureless filament with its tough homogeneous structure, a filament formed without carbon and then carbonized as a whole. Its perfect homogeneity is strongly contrasted with the heterogeneous formation of carbons made of bamboo or other fibre. The object and the results of the process of flashing are also shown very clearly, the more so by the addition of careful drawings, under the microscope, of filaments in various stages of treatment. A considerable portion of the latter part of the paper is taken up with the discussion of the Edison patent claims. Dr. Böhm evidently does not believe in the general construction given to the second claim of Edison's patent in the late decision, he inclines strongly, on the contrary, to the opinion that in view of the specification the structureless filament should be considered entirely independent of Edison's invention, and as forming, with the previously known exhausted globe and leading-in wires, an entirely distinct combination. This is a question which will, of course, come up in the trial of the incandescent lamp case before the Circuit Court of Appeals the coming autumn. The structureless filament has plenty of intrinsic merit and is in its general character very different from the filaments made of fibrous materials; its legal status, however, is not so clear. The whole subject will have to be reviewed in the courts, and the issue must be regarded as doubtful. It may be that the radiometer will appear to play a more important part than in the original trial. It comes dangerously near to the modern incandescent lamp, so near that one application for a patent almost identical with Edison's was denied on a reference directly to Crookes' experiments. At all events the legal expedients in the case are well nigh exhausted, and we may expect in the coming trial before the Circuit Court of Appeals something that, even if not satisfactory, may be regarded as final.

News from the Frankfort Exposition.

By Cable from Carl Hering, Special Correspondent of THE ELECTRICAL WORLD.)

FRANKFORT, Sept. 4, 1891.—The long distance transmission of power plant between Lauffen and Frankfort is now operating 1,000 lights regularly with thoroughly successful results. The motor disabled in the first experiments is expected back on Monday next; it was not seriously damaged, but, owing to hasty construction, developed some faults that ought to be remedied. The experiments over this important line are still in active progress, and valuable results are expected.

The congress of 50 mayors of German cities recently held here was a decided success. There was a lively discussion concerning electrical railways, the point specially raised being a comparison of the Siemens-Halske conduit system and the Thomson-Houston overhead system, which has obtained a foothold in Germany. The overhead wires were treated with more respect—owing, perhaps, to American influence—than is generally accorded them in foreign countries.

The electrical congress is now almost ready to open, and among the notable arrivals are Profs. Ayrton, S. P. Thompson, Dr. J. A. Fleming, Profs. Ferraris, Roiti, Hospitalier, Kohlrausch and Nichols. A large attendance is expected and new delegates are arriving constantly.

Latest Foreign Electrical News.

(By Cable from Our Own Correspondent.)

LONDON, Sept. 4, 1891.—The final report of the Board of Trade committee on electrical standards has just been published. It does not materially differ from the preliminary draught which was published early this year.

The Duke of Marlborough in a long letter to the London *Times* announces the formation of a telephone company to supply lines with metallic circuit service at an annual rental of £10 per year. This is but one of the active enterprises which have been called into existence by the expiration of the telephone patents.

The Manchester municipality is about to raise £50,000 for the establishment of a municipal electric lighting plant.

Electric tramway construction is not just now active in this country. News comes from France that the Clermont-Farrand Electric Railway, which has been in successful operation for a couple of years, is to be extended up Puy-De-dome to an altitude of over 5,000 feet.

Rumored Changes in The Edison Company.

A rumor has been circulated of late that Mr. Henry Villard, the president of the Edison General Electric Company, has resigned. It is impossible to definitely verify this report, but those who are in position to know deny an actual resignation, although freely admitting that a change of administration is impending, and hint that the next annual meeting in January, 1892, may bring about a more or less complete reorganization of the executive department of the Edison Company.

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1768.——Molenier (Jacob), physician to the French King, Louis XV., writes "Essai sur le Mécanisme de l'Electricité" for the purpose of showing the utility of the application of the electric fluid in medical practice. At page 60 he explains the effects and results when applications are made more particularly to the nerves, and at pages 65–97 he gives certificates of many of the cures he has effected of gout, rheumatism, tumors, cancers, loss of blood, as well as of pains and aches of various descriptions.

See Jallabert (A. D. 1749); Lovet (A. D. 1756); Bertholon (A. D. 1780–1781); Manduyt (A. D. 1781); Van Swinden, "Recueil, etc."; La Haye, 1784, vol. II., pp. 122–129 for the experiments of De Sauvages, De La Croix, Joseph Elder von Herbert, H. Boissier and others; Thomas Fowler ("Med. Soc. of London," vol. III.); M. Tsetsel ("Collection Académique," tome XI.); the works of L'Abbé Sans, Paris, 1772–1778; M. de Cazeles Masar's "Mémoires and Recueils," published 1780–1788, and reproduced in vols. II., III. of the "Mémoires de Touloux"; Jacques H. D. Petetin ("Actes de la Soc. de Lyon," p. 230); M. Partington (*Jour. de Phys.*, 1781, vol. I.); Dr. Andrew Duncan's "Medical Cases," Edinburgh, 1784, pp. 135, 191, 235, 320; C. A. Gerhard ("Mém. de Berlin," 1772, p. 141); *Jour. de Phys.*, 1783, vol. II.); J. B. Bohadsch, "Dissertatio, etc.," Prague, 1751 (*Phil. Trans.* for 1752); Patrick Brydone (*Phil. Trans.* for 1757); Geo. Wilkinson, of Sunderland, "An account of good effects, etc.," in *Medical Facts, etc.*, 1792, vol. III., page 52; M. Carmoy, "Observ. sur l'El. Med.," Dijon, 1784; M. Cosnier, M. Malvet, Jean Darcet, etc., "Rapport, etc.," 1783; Le Camus, "Dissertatio, etc.," 1761; Le Comus, "Osservazioni, etc.," 1776 (*Jour. de Phys.*, 1775, vols. V. and VI.; 1776, vol. VII.; 1778, vol. I.; 1781, vol. II.); Ledru. "Sur le traitement, etc.," 1783; Le Dr. Boudet, "De l'Elec, en Medecine," conférence faite à Vienne le 6 Octobre, 1883.

A. D. 1769.——Bancroft (Edward Nathaniel), a resident physician of Guiana, openly expresses the belief that the shock of the *torpedo* is of an electrical nature. He alludes ("Natural History of Guiana") also to the *gymnotus electricus*, which, he says, gives much stronger strokes than the *torpedo*; the shocks received from the larger animals being almost invariably fatal.

The discharge of the *gymnotus* has been estimated to be equal to that of a battery of Leyden jars of three thousand five hundred square inches, fully charged. At a later date, the American physicians, Gordon and Williamson, showed that as the fluid discharged by that fish "affects the same parts that are affected by the electric fluid; as it excites sensations perfectly similar; as it kills and stuns animals in the same manner; as it is conveyed by the same bodies that convey the electric fluid and refuses to be conveyed by others that refuse to convey the fluid, it must itself be the electric fluid and the shock given by the eel must be the electric shock."

Humboldt, speaking of the results obtained by Mr. Fahlberg, of Sweden, says: "This philosopher has seen an electric spark, as Walsh and Ingen-houz had done before him at London, by placing the *gymnotus* in the air and interrupting the conducting chain by two gold leaves pasted upon glass and a line distant from each other." (*Edinburgh Journal*, vol. II., page 249.) Faraday, who gives this extract at paragraph 358 of his "Experimental Researches," says he could not, however, find any record of such an observation by either Walsh or Ingen-houz and does not know where to refer to that by Fahlberg. (See the note accompanying aforenamed paragraph.)

See *Annales de Chimie et de Physique*, vol. XI.; *Phil. Trans.* for 1775, pp. 94, 102 (letter of Alexander Garden, M. D.) 105, 395; "Acad. Berlin," 1770, 1786; Fifteenth series Faraday's "Exper. Researches," read December 6, 1838; Sir David Brewster's "Edinb. Jour. of Science," 1826, vol. I., p. 96, for the observations of Dr. Robert Knox; G. W. Schilling: at Ingen-houz' "Nouvelles Expériences," p. 340, as well as at note, p. 439, vol. I., of Van Swinden's "Recueil, etc.," La Haye, 1784; also G. Schilling's "Diatribe de morbo in Europâ penè ignoto," 1770; article "Physiology" in the "Encycl. Brit."; Aristotle (B. C. 341), Scribonius (A. D. 50), Redi (A. D. 1678), Kaempfer (A. D. 1702), Adanson (A. D. 1750); *Sc. Am. Suppl.*, No. 24, p. 375 (for Mr. Rouget's observations on the gymnotus) and No. 457, p. 7,300; M. Bajou, "Descrizione di un pesce, etc.," Milano, 1775 (*Phil. Trans.*, 1773, page 481); M. Vanderlot's work on the Surinam eel, alluded to at page 88 of "Voyage Zoolcgique," by Humboldt, who publishes in Paris, during 1806 and 1819, special works on the gymnotus and upon electrical fishes generally.

A. D. 1769.——Cuthbertson (John), English philosophical instrument maker, publishes the first edition of his interesting work on electricity and galvanism.

He is the inventor of the *balance electrometer*, for regulating the amount of a charge to be sent through any substance, as well as of an electrical condenser and of an apparatus for oxidating metals, all of which are respectively described at pages 620, 614 and 593, vol. VIII., of the 1855 "Encycl. Britannica."

At the end of part VI. of his "Practical Electricity and Galvanism," Cuthbertson gives the conclusions he reaches from his numerous experiments with wire. These, as well as Mr. George Adams' own observations ("Essay, etc.,' 1799, p. 285), proved that the quantity of electricity necessary to disperse a given portion of wire will be the same, even though the charged surface should be greatly varied; or that equal quantities of electricity in the form of a charge will cause equal lengths of the same steel wire to explode, whether the jar made use of be of greater or less capacity. (See *Nicholson's Journal*, vol. II., page 217.)

During his many experiments Cuthbertson made the singular discovery that a battery composed of fifteen jars and containing 17 square feet of coated glass, which, on a very dry day in March, 1796, could only be made to ignite from 18 to 20 inches of iron wire of one $\frac{1}{150}$ part of an inch in diameter, took a charge which ignited 60 inches when he breathed into each jar through a glass tube. (Noad, "Manual," p. 122; also Cuthbertson, "Prac. Elec. and Magnetism," 1807, pp. 187, 188.)

See Cuthbertson's communication to the "Emporium of Arts," vol. II., p. 193, regarding his experiments on John Wingfield's "New Method of Increasing the Charging Capacity of Coated Electric Jars"; Cuthbertson's "Electricity," parts 8, 9 and 11; Cuthbertson's letter addressed to *Nicholson's Journal*, vol. II., p. 526, also *Phil. Mag.*, vol. II., p. 251, for electrometers; Cuthbertson's several works published at Amsterdam and Leipsic, 1769–1797, and alluded to in *Phil. Mag.*, more particularly at vols. VIII., p. 358; IX., p. 83; XXIV., p. 170; XXXVI., p. 259, as well as at p. 313, vol. XII., of J. B. Van Mons' *Journal de Chimie; Nicholson's Journal*, vol. II., p. 525; VIII., pp. 97, 205, and the New Series, vol. II., p. 281; Gilbert's *Annalen*, vol. III., p. 1; "Bibl. Brit. Sc. et Arts," Genève, 1808, vol. XXXIX., p. 118; Noad's "Manual," p. 118; Van Marum (A. D. 1733); Harris, "Electricity," p. 103, and his "Frictional Electricity," p. 76; C. H. Wilkinson, "Elements of Galvanism, etc.," London, 1804, vol. II., pp. 242, 266–268; *Phil. Trans.*, 1782, for a Brooks electrometer, which apparatus is described in the latter's work published, under the head of "Miscellaneous Experiments," at Norwich, 1789, as well as in the "Electricity" article of the "Encyl. Britannica."

A. D. 1770.——Hell—Hehl—Heyl—Höll (Maximilian), member of the order of Jesuits and professor of astronomy at Vienna, who had great faith in the influence of the loadstone, invented a peculiar arrangement of steel plates to which he afterward attributed the cure "with extraordinary success" of many diseases, as well as of a severe attack of rheumatism from which he, himself, had long suffered.

He communicated his discovery to Anton Mesmer, who was so strongly impressed by Hell's observations, which illustrated his own theories respecting planetary influence, that he immediately procured every conceivable description of magnet and made experiments which led to his introduction of animal magnetism or rather *mesmerism*.

To Father Hell is attributed the publication, in 1776, of a '*New Theory of the Aurora Borealis.*"

See Beckmann, Bohn, 1846, vol. I., p. 44; *Practical Mechanic*, Glasgow, 1843, vol. II., p. 71; Van Swinden, "Recueil, etc.," La Haye, 1784, vol. II., pp. 303, 304, etc.; J. Lamont, "Handbuch, etc.," p. 436.

A. D. 1771.——Morveau (Baron Louis, Bernard Guyton de), a very prominent French chemist and scientist, publishes at Dijon his "Reflexions sur la boussole à double aiguille," and, later on, communicates to the *Annales de Chimie*, vol. LXI., p. 70, and vol. LXIII., p. 113, very valuable papers treating on the influence of galvanic electricity upon minerals, which are publicly read before the French Institute.

See Thompson, "Hist. of Chemistry," vol. II., 1831; the translation of Morveau's letter to Guénaud de Montbéliard in *Scelta d'opuscoli*, vol. XXXIII., p. 60; Berthollet, "Discours, etc.," 1816; "Biog. Univ.," tome 18, pp. 296–298; "Biog. Univ. et Portative, etc.," 1834, vol. III., p. 701; *Annales de Chimie*, vol. LXI., pp. 70–82; Sir Humphry Davy, "Bakerian Lectures," London, 1840, p. 51.

A. D. 1771.——In an extensive article published by the *Gazette* at Salem (Mass.), Aug. 9, 1889, on the occasion of the formal opening of the new station of the Electric Lighting Company, the connection of that city with the progress of electricity was traced in the following manner:

"In 1771 Col. David Mason, a prominent figure among the patriots at Leslie's Retreat, gave a course of lectures on 'Electricity' at his house near North Bridge. The Rev. John Prince, LL. D., minister of the First Church from 1779 to 1836, was especially interested in electricity, and is said to have made the first electrical machine in Salem, if not in the country. Col. Francis Peabody, assisted by Jonathan Webb, the apothecary, was much interested in the subject, and, in 1829, gave a series of lectures, illustrated with a machine made by himself, which had a glass plate wheel imported from Germany at a reported cost of $1,500."

"Dr. Charles Grafton Page, another native of Salem, invented the first electric motor in which solenoids were used, and as early as 1850 constructed a motor which developed over 10 h. p. The next year he made a trial trip with his electro-magnetic locomotive over the Baltimore & Washington Railroad. Prof. Moses Gerrish Farmer lived on Pearl street, between the years 1850 and 1870, and, as far back as 1859, illuminated the house with divided electric lights—probably the first time that any house in the world was lighted by electricity. In 1847 Prof. Farmer had constructed and exhibited in public an electro-magnetic locomotive drawing a car holding two passengers, on a track one foot and a half wide."

"Many of Prof. Alexander Graham Bell's early experiments were conducted in Salem, and the first lecture on the telephone in this country, if not in the world, was delivered by him before the Essex Institute in Lyceum Hall, February 12, 1877. The late Prof. Osborn, teacher of chemistry and physics at the Normal School in this city, was also an electrical expert. He exhibited the first arc lights in Salem, and was the inventor of the storage battery system from which lights were exhibited."

The advertisement which appeared in the Salem *Gazette* of Tuesday, January 1, 1771, is thus worded: "To-morrow evening (if the Air be dry) will be exhibited A Course of Experiments in that instructive and entertaining branch of Natural Philosophy called Electricity; to be accompanied with Methodical Lectures on the nature and properties of the wonderful element; by David Mason, at his dwelling-house near the North-Bridge. The course to consist of two lectures, at a pistareen each lecture."

A. D. 1771.——Milly (Nicolas Christiern de Thy, Comte de) French chemist, constructs compass needles of an alloy of gold and ferruginous sand. These needles answered well their purpose, as did also the brass needle owned by Huyghens, a fact which received the confirmation of Messrs. Du Lacque, Le Chevalier d'Angos and Mr. Arderon, while the latter further ascertained that he could impart a feeble though distinct magnetic force to a brass bar either by striking it or by means of the "double touch."

See "Biog. Univ.," vol. XXVIII., page 312; *Journal de Physique*, tome XIII., p. 393; *Philosophical Transactions*, vol. L., p. 774; Du Hamel, "Hist. Acad. Reg. Paris," p. 184; *Journal des Savants*, Paris edition of December, 1772, and Amsterdam edition of January, 1773.

*Continued from THE ELECTRICAL WORLD, Sept. 5, 1891.

Some of Our Canadian Allies.

We present herewith a few portraits of some of the gentlemen through whose courtesy and activity the National Electric Light Convention has been able to hold its present convention in Montreal. No more cordial and active support has at any time ever been accorded to the association than at the scene of this semi-annual convention.

Lord Stanley of Preston, G.C.B., is the present Governor General of Canada. Lord Stanley succeeded the Marquis of Lorne in his present distinguished position about a year and a half ago, and his administration has been an honorable, dignified and successful one. He has won the highest respect and esteem of all the citizens of the Dominion, and it is appropriate here to add a word of thanks for his cordial assistance in furthering the visit of the National Electric Light Association to Montreal.

COL. A. A. STEVENSON.

Prof. Henry T. Bovey, M. A., M. Inst. C. E., F. R. S. C., professor of civil engineering and Dean of the Faculty of McGill University, is a native of Devonshire, England, and was educated there. He is an engineer of widely recognized ability and has held his present chair since 1878. The department of electricity in McGill University comes directly under Prof. Bovey's care, and he is just now about completing the thoroughly equipped laboratories for the practical study of the branch of engineering with which he is thoroughly familiar. This department is in the Macdonald technical building, just finished, and is open to the inspection of the visiting association. Prof. Bovey is the active and efficient chairman of the Citizens' Committee of Montreal, and much of the elaborate preparation that has

ALBERT J. CORRIVEAU.

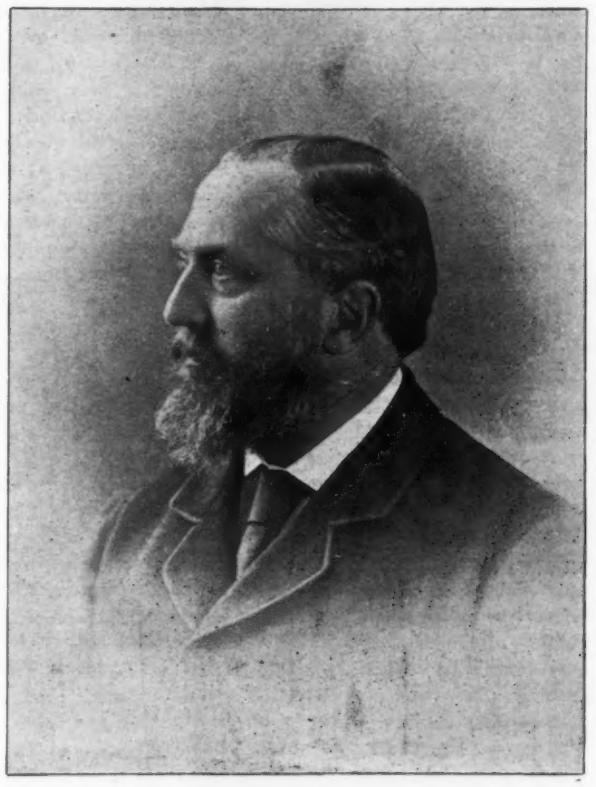
been made for the reception and entertainment of the National Electric Light Association is due to his personal care.

There are very few electricians in the Dominion of Canada and not very many in the eastern United States who do not know by reputation at least John Carroll, the manager and treasurer of the Eugene Phillips Company, of Montreal. Though young in years he has been in the electrical business for a long time, beginning as a telephonist, stationed in Providence, R. I. He continued in this service for some eight years, when his activity and ability brought him to the attention of Mr. Phillips and in a short time he was in his present position as manager of the principal wire factory of the Dominion of Canada. He is widely known both professionally and socially and this is evidenced by his being put on every committee on which it was possible for him to be appointed.

Mr. Albert J. Corriveau, president and general manager of the Canadian Electrical Construction Manufacturing and Supply Company of Montreal, is a gentleman to whom more than to any other one person is due the credit of the visit of the association to Canada. At the last two conventions he has

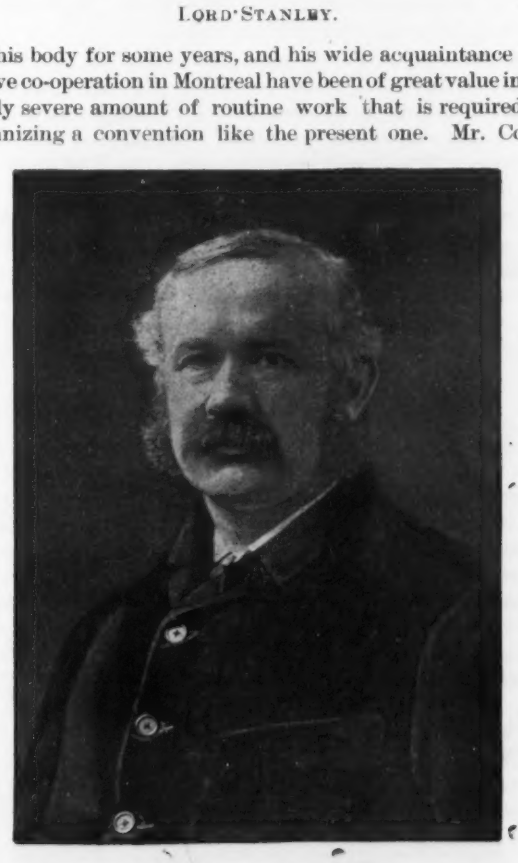
FREDERIC NICHOLLS.

been present and extended the most cordial and urgent invitations on the part of the electrical fraternity of the Dominion for a visit of the National Electric Light Association at the very earliest opportunity. He has been a member



LORD STANLEY.

of this body for some years, and his wide acquaintance and active co-operation in Montreal have been of great value in the really severe amount of routine work that is required in organizing a convention like the present one. Mr. Corri-

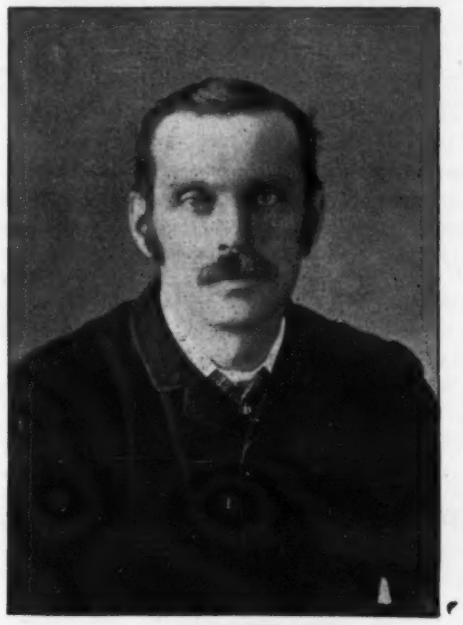


PROF. HENRY T. BOVEY.

veau was for some years connected with the great silk house of Givernaud Brothers, of New York, and afterwards was the pioneer in establishing the silk industry in Canada. When the Royal Electric Company engaged in active operations in Montreal, Mr. Corriveau became intensely interested in electrical work, and finally devoted his attention entirely to it and became general manager of the Royal Electric Company, in Montreal, for some years, only leaving that organization to organize his present company, which is engaged in pushing things electrical with the greatest activity.

Lieut. Col. A. A. Stevenson, the chairman of the Montreal Board of Aldermen, is a gentleman who has been tireless in his efforts to help along matters pertaining to the Convention. Col. Stevenson is a Scotchman by birth but has been many years in Canada and has for a long time been prominent in political life. Besides being chairman of the Board of Aldermen he is chairman of the fire committee, and has taken an active part in the management of the Montreal fire department, and has materially aided in bringing it to its present high development.

An enthusiastic electrician, Mr. F. R. Redpath has left nothing undone that could aid the National Electric Light



F. R. REDPATH.

Association in its present convention. He is a member of several of the committees and has persistently co-operated in the work of organization. Mr. Redpath himself is an expert electrician, and in his residence is one of the most complete private installations to be found on this continent. It is of a type frequently used abroad but much less frequently used here.

Few Canadian gentlemen are as well known as Mr. Frederic Nicholls, of Toronto, whose personal popularity, as well as his connection with the press and his commercial enterprises, all of which have proved profitable, has brought him prominently before the public.

At the various meetings of the Association of the Edison Illuminating Companies Mr. Nicholls has always taken an

JOHN CARROLL.

active part, and on his invitation the members of that association will gather in Toronto in 1892. Mr. Nicholls' latest electrical investment was the formation of the Toronto Construction and Electrical Supply Company in March last, his associates in this undertaking being gentlemen of high financial and social standing, who elected Mr. Nicholls second vice-president and general manager. The enterprise is proving of far more importance than was deemed possible at the beginning, and already branch stores have been formed.

At the Providence meeting of the National Electric Light Association Mr. Nicholls was an interested member, and was urged to allow his name to be added to the list of officers. Let us trust that he will hereafter take a more active part in the affairs of the association, as his wide experience in central station management will certainly make his services of value to his brother members.

The Elements of Practical Electricity.*

BY DR. LOUIS BELL.

If one were deliberately to investigate the relative ability of various materials to convey the impulse, whatever it is, that springs from the ends of the voltaic pile, apparatus of a somewhat delicate character would be required and sources of electricity more constant and powerful than those we have already described. The method of conducting such a test will be given later, but its results in a general way are stated here for the convenience of the student.

CONDUCTORS AND NON-CONDUCTORS.

Among good conductors would be found a list somewhat like the following, those best able to conduct the electric impulse being placed first:

Metals,	Concentrated acids,	Spring water,
Dense charcoal,	Dilute acids,	Rain water,
Plumbago,	Saline solutions,	Moist earth,
Other forms of carbon except diamond,	Metallic ores,	Wetted paper, cloth, etc.
	Sea water,	

Among very bad conductors would be enumerated:

Oils,	Dry paper,	Sulphur,
Leather,	Silk,	Resins of various sorts,
Parchment,	Mica,	Gutta percha,
Stones of various kinds,	Glass,	Shellac,
	Wax,	Ebonite.

In general silver is the very best of all conductors and shellac and ebonite are the worst. These very bad conductors are generally known as insulators, or non-conductors. Among the metals themselves there are considerable differences in power of transmitting the electric current, but the very worst of the metals is a far better conductor than the best of the poor conductors; in fact, metals stand quite alone in conducting power. If one were to take a series of metallic wires of the same length and diameter and test, as can be done by proper instruments, their relative power of conduction, the list would run about as follows, silver being the best and counted as 100:

Silver	100	Zinc	29	Lead	8.3
Copper	99.9	Platinum	18	Antimony	4.6
Gold	77.9	Iron	16	Mercury	1.6
Aluminium	55	Nickel	13	Bismuth	1.2

Most carbon would be represented on the same scale as 0.07 or thereabouts, varying quite widely in different specimens.

Whatever the energy transmitted along a conductor from one end of a voltaic pile or battery to the other may be, we can readily find by experiment that it confers upon the conductor some very remarkable properties. In order to

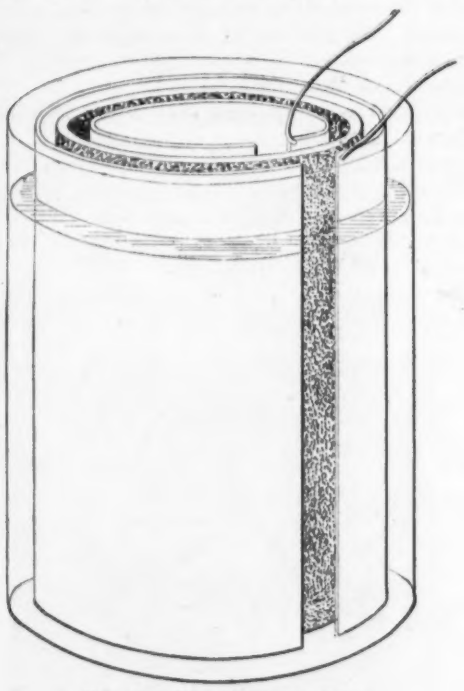


Fig. 4.—The Daniell Cell.

experiment on the subject, however, it is advisable to construct a rather more effective source of electricity than any of those I have yet described.

CONSTRUCTION OF THE DANIELL CELL.

To this end you might proceed as follows: Procure a couple of glass or earthenware jars from four to five inches in interior diameter and five or six inches high, it makes little difference what these are; very wide-mouthed bottles, fruit jars with the tops knocked off, or anything of a similar kind, will answer admirably. Then get two cups of porous earthenware—these can best be bought from some of the many electrical supply companies that are within reach. These porous cells should be cylindrical, about 2½ inches outside diameter and perhaps six inches high. Next secure two sheets of thin copper six inches square, and two sheets of zinc six by nine inches; bend each of these into cylindrical shape, forming two zinc and two copper cylinders about six inches high and about three and two inches in diameter respectively. You are now ready to proceed with the construction of the battery. Solder a wire to a corner of each sheet, place the zinc cylinders in the glass jars, inside these put the porous cups, and still inside these the copper cylinders, then make a very strong solution of copper sulphate (blue vitriol) and fill the porous cups with it nearly to the top of the copper cylinders. Fill the outer space around the zinc with the same solution used in the voltaic battery, composed of about one part of sulphuric acid to 30 or 40 of water. You have then built up two Daniell cells (Fig. 4.) They are not capable of giving a very powerful current but are very steady and reliable sources of electricity. With the voltaic battery previously described little bubbles of gas will form on the copper plate, partially covering it and interfering with the action of the battery; these do not appear in the Daniell cell, as the gas as soon as formed is taken up by the copper sulphate. If the wires from the zinc and copper plates of a single cell be joined together, however, for a short time, on withdrawing the copper you will notice that the surface looks uncommonly bright and clean, and closer examination will show that a thin coating of metallic copper has been formed upon it. If the battery is kept in action over night, for example, you will find in the morning that the zinc has been very much corroded, and that not only has metallic copper deposited itself over the copper plate, but the blue solution of sulphate of copper in

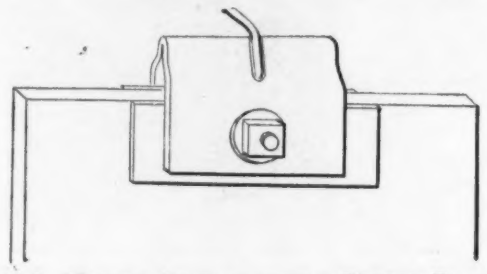


Fig. 5. Making Contact with a Carbon Plate.

the porous cups has become very much weaker, as shown by a lighter color. This at once suggests the source of the deposited copper, which has been obtained at the expense of the copper sulphate. The real action is the decomposition of the copper sulphate into the two things (copper and sulphuric acid), from which it was originally formed, and this has been accomplished by the action of the battery itself. The electric current, therefore, whatever it may be, has the power of decomposing some chemical compounds, in fact nearly all of them if the current is powerful enough. At the same time one can see, as, indeed, is shown by the liberation of gas on copper in the voltaic battery, that whatever the electrical influence is, it is working just as much in the conducting liquid of the cell as it is, for instance, on the tongue when placed between the wires leading from the zinc and copper plates. Some minor points may here be noted regarding the construction of any cell, whether of the original form or the improved kinds, of which the Daniell is one. For practical use it is better to employ zinc considerably thicker than the ordinary rolled zinc commonly to be found, because as the battery works the zinc is gradually consumed and will have to be replaced more frequently the thinner it is. If convenient, therefore, it is better to get regular zincs which are made for the purpose, usually an eighth of an inch thick, and bent into cylinders ready for use. In making up the Daniell cells or any other batteries which are to be kept in action for a considerable length of time, it is best to amalgamate the surface of the zinc, as this prevents to a considerable extent corrosion when the zinc is left in the acid, but the wires from the zinc and copper plates are not joined, that is, when the battery is on "open circuit." Amalgamation is readily done by dipping the zinc in the battery acid for a minute or two and then—working over a plate so as not to waste mercury—rubbing mercury on the zinc with a rag until the surface looks white and silvery.

Another point to be remembered is that the two working plates of the battery, whether copper and zinc or any other material, should be put as near together as practicable, provided that they do not touch and the liquid has free access to them. This should be done because, as I have already explained, liquids are very poor conductors and as short lengths as possible of them should, therefore, be put in the circuit through which the electricity is to travel. For the same reason the bigger the immersed surface of the plates the more space free to be traversed by the electricity, and hence the fluid, even though a poor conductor, does not so much hinder the action of the battery.

THE BICHROMATE CELL.

The principal virtue of the Daniell form of cell is its great reliability and the steadiness of the supply of electricity that may be derived therefrom. For some purposes where a very plentiful supply of current is desired other batteries are better adapted, and a couple of cells of one of these had better be constructed, as they will prove useful in many of the succeeding experiments. The particular form that will be most convenient is what is generally known as the bichromate battery, sometimes called the Grenet battery. For making this the only materials that will not be found readily at hand are the battery jars and the carbon plates, which replace in this case the copper of the voltaic cell. Get two glass jars about six inches in diameter and eight inches high, which can be obtained from any dealer in electrical supplies; also buy four carbon plates about nine inches long by five wide, they will be from a quarter to half an inch thick probably, the exact figure does not matter much. Now prepare a strip of board something as shown in Fig. 6; it should be about eight inches long and two and a half wide, and an inch or an inch and a quarter thick; cut in it with a fine saw two slots just long enough and wide enough to fit the carbon plates snugly, and half an inch apart at their innermost edges. Midway between these slots cut another one parallel to them for the reception of the zinc plate, if ordinary sheet zinc is used a mere saw cut will be sufficient, if you can obtain thicker zinc a cut proportionately wider. Cut out a pair of zincs the same size as the carbon plates. Then prepare the latter for proper connection with the wires that will convey the current from the battery. To do this bore with an old bit or the corner of a broken file a hole through each carbon plate about a quarter of an inch in diameter and half an inch from one end; then for each plate prepare a piece of rather stout sheet lead four inches long and two inches wide; scrape the surface clean and bend the lead up, as shown in Fig. 5, so that it will press against the carbon at every point, with the lead rising slightly above the upper edge of the carbon; punch holes through the lead to correspond with the hole in the carbon. Then take an ordinary machine screw or short bolt and clamp the lead tight against the carbon. It is best in doing this to use an iron washer two inches long and about half an inch wide, so that the lead will be firmly pressed against the carbon at every point. Now put in your bolt and screw the nut on tightly, clamping the lead firmly in position. Having prepared the four plates in this manner, shove a pair of them through the slots in the board you have made so that they will project about eight inches below it, then slide in your zinc plate, to which a copper wire has been previously soldered, in the central slot, and also solder copper wire across the tops of the two lead clamps connecting both carbon plates together. For the battery solution you will require something very different from anything mentioned previously. Make a mixture of three parts by weight of sulphuric acid with nine parts of water, pouring the acid very slowly into the water, and keeping it continually stirred; the mixture will heat violently and it is not a bad idea to put the jar in which the mixing is done in a pail of water so as to avoid danger of breaking it. Procure a few ounces of potassium bichromate, take a weight of it equal to about one-third the weight of the acid you have used, and powder it finely; carefully avoid getting any of the dust in your nose or eyes, as it is very corrosive and unpleasant. Dissolve the powdered bichromate in the acid solution gradually, fill your battery jars up to within a couple of inches of the top with this mixture, and then plunge in the zinc and carbon plates, letting the board rest on the top of the jar. The bichromate battery will produce

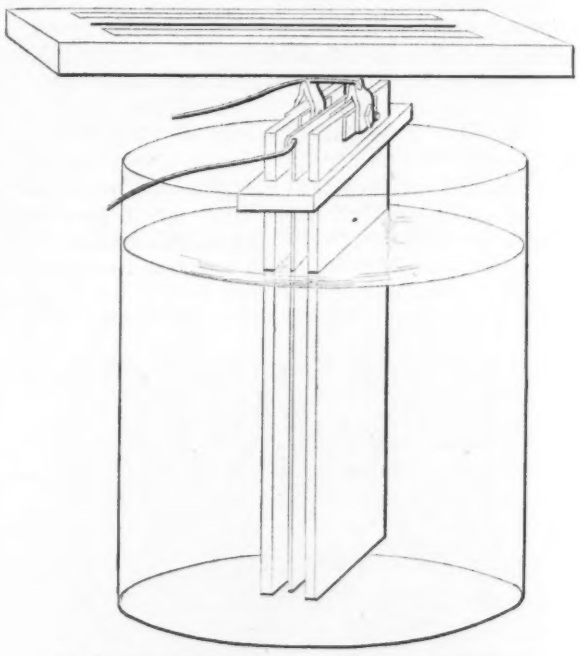


Fig. 6.—Construction of a Bichromate Cell.

much more powerful effects than the Daniell cells you have previously worked, but cannot be used more than 15 or 20 minutes at a time without its power falling off rapidly. When the battery is not in use remove the plates and wash off the solution that clings to them.

(To be continued.)

* Continued from The Electrical World, Sept. 5, 1891.

The Mechanical Equivalent of Heat.

A note has been received by the Paris Académie des Sciences from M. Constantine Miculesco on a new determination of the mechanical equivalent of heat. The principle of the method was the same as Joule's, viz., the production of heat in a calorimeter by means of friction. The whole of the work done by Joule's experiments, however, was small, and hence a good time was required to obtain a sensible heating of the calorimeter, and some difficult corrections had to be made. To prevent this, M. Miculesco used a fairly powerful electromotor to supply the work which was to be turned into heat. The apparatus comprised a one horse power Gramme electromotor, carried on a frame suspended on knife edges, the motor shaft being central with the line of these supports. On a separate frame was mounted a calorimeter consisting of two concentric cylinders, so that the axes of the cylinders coincided with the centre line of the motor shaft. By means of a flexible connection this shaft was coupled to one bearing paddles, which it caused to revolve in the water in the cylinders. Under such circumstances the frame carrying the motor

tended to swing on its knife edges in order to balance the torque on the motor shaft, and by correcting this tendency by carefully adding weights, this torque could be measured with great accuracy. The result obtained was $J = 777.7$ foot-pounds.

The Progress in the Art of Modern Incandescent Lighting.

BY DR. L. K. BÖHM.

The state of the art prior to the commercial introduction of the incandescent lamp in 1880 will be shortly reviewed only, because the art, up to that time, was practically in an experimental condition and with but few exceptions, which will be later mentioned, had not left the laboratories of scientists and inventors.

The principle of producing light by incandescence, according to Dr. Werner Siemens in Berlin, was first demonstrated by Professor Jacobi, of St. Petersburg, before 1840. This scientist is known to Americans as the builder of the first electric boat, which he exhibited on the river Neva in Russia about 1837. King in his English patent of Nov. 4, 1845, describes carbon in vacuo. In the same year Grove, the inventor of the Grove cell, published in the *Philosophical Magazine*, vol. XXVII., an account of his incandescent platinum lamp which he had constructed in 1840. Prof. J. W. Draper experimented in 1847 with incandescent platinum and the results are described in *Silliman's Journal*, 2d series, vol. IV., 1847. De Changy in 1852 tried to subdivide the current and produced light by incandescent platinum spirals. He had a patent granted to him in Belgium. According to Mousson's "Physik" Dr. H. Geissler invented the first mercurial air pump as early as 1858. During July, 1859, the house of Prof. Moses G. Farmer of Salem, Mass., was lighted by incandescent platinum lamps; so he declared a slate as Oct. 30, 1879. About 1860, Dr. H. Geissler invented the celebrated electrical tubes bearing his name. Iu 1864 Sprengel invented his mercurial air pump. Lodyguine, a Russian physicist, constructed a lamp with two carbon rods in an exhausted chamber in 1873, and the following year he was awarded a prize for his researches on that subject by the Academy of Sciences of St. Petersburg. His carbons were made thinner, *i. e.*, of smaller diameter, and consequently of higher resistance in the place to be heated up to incandescence. Konn, in 1875, made lamps with thin carbon rods in an exhausted chamber, Fig. 1. Three of these lamps were burned in the linen store of Mr. Florent in St. Petersburg for two years. The current was furnished by an Alliance machine. Florent said that he used the electric light of Konn, although it was rather expensive, because it was so clean and his linen did

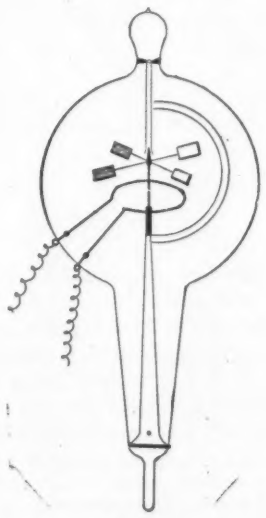


FIG. 2.

not turn yellow as it did when gas was used. The two last mentioned lamps are described in Dr. H. Schellen's "Die neuesten Fortschritte, etc.," 1880, and "L'eclairage Electrique," by du Moncel, Paris, 1880. Bouliguine soon replaced the fine carbon rods of Konn by a thin, long carbon. The electricians of the United States Torpedo Station at Newport, R. I., in 1876, produced light by rendering incandescent thin strips of platinum or iridium. Hiram S. Maxim constructed, in December, 1877, a platinum lamp with a thermostatic circuit regulator to prevent the fusion of the platinum burner. The patent was issued Sept. 30, 1881. Sawyer and Man, in 1879, experimented with carbon rods in artificial atmosphere. After the air was excluded from the glass chamber such gases as cannot combine chemically with carbon were introduced, as for instance, nitrogen and hydrogen. In the course of these experiments they heated carbon rods to incandescence in an atmosphere of illuminating gas, of hydrocarbon gas, and in a bath of hydrocarbon liquid. These experiments led to the remarkable and, in the manufacture of incandescent lamps, indispensable process known in our days as the flashing or treating. A patent was granted to them for this invention, Jan. 7, 1879. During 1877 and 1878 William Crookes made experiments on radiant energy, by which he tried to prove the existence of a fourth state of matter, and on April 19, 1878, he published in the London *Engineering* a description and illustration of a radiometer, which was provided with a platinum ring inside the glass globe under a little fly wheel. This platinum ring, when incandescent, maintained the little wheel in continuous revolution—Figs. 2 and 3. Crookes' radiometers were all very highly exhausted. Lamps constructed by Lontin and Fontaine did not present noteworthy features. Reynier and Werdermann constructed lamps on a principle known as the Werdermann system. A slender carbon rod presses against a heavy disc of carbon making actual contact, but the lamps are not arc lamps, and are not exactly incandescent lamps. Werdermann lamps were used at the Kensington museum in London, and the way in which the current was distributed is very interesting. Fig. 4 explains itself. The ten lamps are placed in multiple arc with a slight resistance each. *La Lumière Electrique*, of July 15, 1879, page 72, says the light had been of an agreeable softness and steadiness. The current was furnished by a Gramme machine designed for electro-plating. On Oct. 5, Nov. 14, and Dec. 3, 1878, Edison filed three applications for incandescent platinum lamps with thermostatic regulators on the same principle as Maxim's lamp of December, 1877. Lane-Fox on Oct. 9, 1878, filed a provisional specification for incandescent platinum lamps of high resistance for parallel distribution. (Lane-Fox English patent, No. 3,988, of 1878). Edison on April 21, 1879, filed an application for a patent for an incandescent platinum lamp of high resistance for parallel distribution. The burner consisted of platinum wire wound on a cylinder of lime. The patent was issued March 8, 1880, and a French patent was granted to him May 28, 1879. These two lamps, one of Lane-Fox and one of Edison, are the first high resistance lamps for parallel distribution, and as Edison describes and claims a hermetically sealed vacuum chamber made entirely of glass, it is necessary that we examine the specification and drawing of that patent a little closer. A passage of the specification reads: "The drawing shows a section of the apparatus in which *B* is the transparent bulb. This bulb is open at the smaller end and the burner *d* inserted, and the open end of the tube is placed in connection with a mercury vacuum pump, the platinum wires *g* and *f* passing through. . . . When the vacuum is considered practically perfect the open end of the tube is melted and sealed. The platinum wires passing through the glass are also sealed." How is it possible to seal "the open end of the

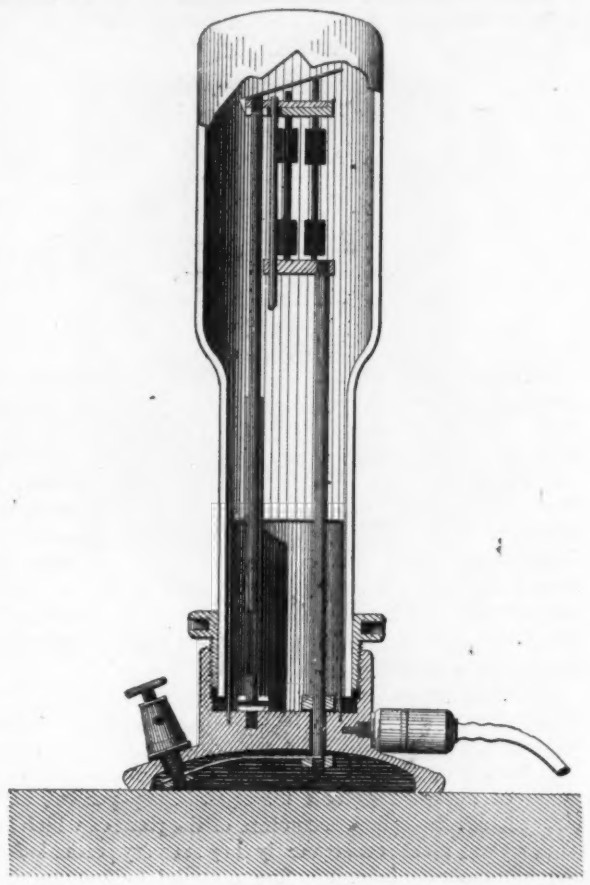


FIG. 1.

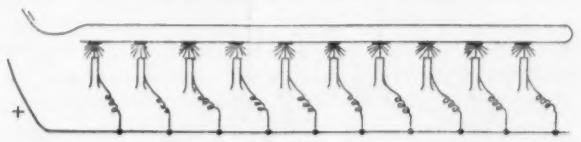


FIG. 4.

tube," through which the burner was inserted, after a vacuum is created? When were the platinum wires sealed? The passage quoted indicated that the wires were also sealed after the vacuum was created, and that is an impossibility and absurdity, because the pressure of the atmosphere will in every instance force holes into an exhausted glass chamber when so much heat is applied as is necessary for sealing the wires. And one skilled in the art will not be able to make such a lamp according to that description. Further, the lamp does not constitute a modern commercial incandescent lamp in that it has of course a platinum burner in place of a carbon filament. Fig. 5 shows a plug inside the glass chamber, which presses against the lower narrower part of the chamber and so holds the lime cylinder with platinum burner in position. This plug is not hermetically sealed in the glass by fusion, while a modern commercial incandescent lamp consists of two essential parts, viz.: (1) the outside part or globe or bulb; (2) the inside part or support with burner attached to the platinum wires sealed in the inside part. Both are hermetically sealed or joined by fusion prior to the creation of a vacuum.

The latter part of 1879 brought the experiments with high resistance carbon filaments, but before entering upon that subject we will look back and see what vital or essential parts or elements of the modern lamp had been developed by this time. The modern lamp as stated above consists of two parts, the glass globe and the inside part with sealed-in wires, to which the incandescent conductor is attached; both are hermetically sealed by fusion of the glass prior to the creation of the vacuum. The latter is made as high as practically attainable. We have seen that Geissler had invented in 1858 his mercurial air pump, and Sprengel, in 1874, the tubular mercury pump. The apparatus for producing high vacua were there and were before 1879 so perfect that Geissler could make spark tubes and Crookes his researches on the fourth state of matter. It was only a matter of manual skill to produce high vacua. The spark tube or vacuum tube, as it is also called, is a plain Geissler tube, so highly exhausted that a spark from a Ruhmkorff coil, say two inches long in the open air, would not pass any more between the electrodes although they were often only one millimetre apart. (Fig. 6.) Such a tube sealed on a mercury air pump was often used to determine the degree of exhaustion. Then it was called a vacuum tube or vacuum gauge. If the rarefication had reached a certain point then say a one inch spark would not pass any more, but if a two inch spark was then employed the tube was illuminated again. Carrying on the exhaustion further, the two inch spark would not pass any more and so forth. Such vacua and those employed in Crookes' radiometers are higher than the vacua found in incandescent lamps to-day. The spark tube presents another important feature. It is an all-glass closed chamber with leading-in platinum wires sealed in by fusion of the glass, the same way as is done with all Geissler tubes. Lane-Fox, and later, Edison—not to speak of Werdermann's distribution of current—recognized the importance of high resistance filaments to be used in multiple arc, and the Crookes radiometer with the platinum ring had every element of the modern lamp in it arranged in a different way and for a different purpose.

To review, there was at that time:

1. The all-glass closed chamber with leading-in platinum wires, sealed in by fusion of the glass (Geissler tubes, radiometers).

2. The high vacua and the apparatus to produce them (spark tube, radiometer, Geissler pump, Sprengel pump).

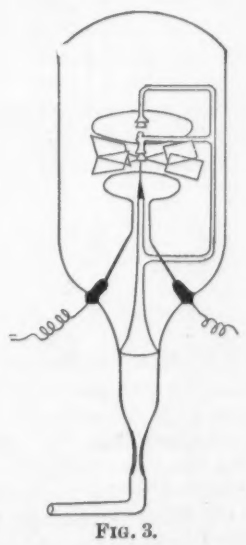


FIG. 3.

3. High resistance filaments for parallel distribution (platinum filaments, Lane-Fox, Edison).

4. The incandescent platinum ring in combination with an all-glass closed chamber with leading-in platinum wires in a high vacuum (one style of Crookes' radiometers).

What had to be done now to make a commercial incandescent lamp after all the mentioned essential elements of the lamp were known? Incandescent conductors had to be invented of such a nature and such material as would make the lamp durable and economical enough for commercial use. This was the state of the art and the condition of experimenters when the author of this article became an assistant of Mr. Edison about the middle of August, 1879, in his laboratory at Menlo Park, N. J. In 1877 and 1878 I had been the pupil and assistant of Dr. Geissler in his private laboratory at Bonn on the Rhine. I not only knew the Geissler tubes and radiometers but had made myself all sorts of Geissler tubes and numerous experimental radiometers. I knew the Geissler pump and its manipulation, for I had exhausted all the experimental radiometers myself; I had, in other words, produced numerous high vacua. At Edison's laboratory I had to make first mercurial air pumps, and soon succeeded in making them of high efficiency by combining the Geissler and Sprengel pump. In testing such pumps a vacuum was produced, in one instance, so high that the spark of a Ruhmkorff coil nine inches long in the open air would not pass the spark gauge. (See *Scientific American*, Jan. 17, 1880.)

The next step taken in Edison's laboratory was the pro-

duction of a platinum lamp. (Fig. 7.) I gave the lamp the shape of a radiometer for the very plain reason that I had made numerous radiometers. It was the easiest way for me to do. I only put the platinum spiral in the place where the little wheel is on the radiometer. The narrow tube for connection with the air pump was exactly in the place where it was put on a radiometer and the lamp was exhausted like a radiometer. This lamp was the first lamp made in Edison's laboratory that had all the elements of the modern commercial lamp arranged as they are in lamps to-day. The inside part with the leading-in wires I made separately. That part of the work then passed into the hands of Mr. Batchelor, Edison's most skilled assistant, who mounted the platinum spiral. Then I sealed the inside part with the spiral fastened to it in the globe by fusion of the glass, prior to the creation of the vacuum, and the lamp was then exhausted. By comparison with the Crookes radiometer it is plainly seen that both contain, except the wheel, exactly the same elements, but differently arranged. After the lamp was exhausted it was sealed off the same way that Geissler tubes and radiometers are sealed off. Meanwhile Mr. Edison himself was very busy with his European telephone, the chalk buttons of which caused so much trouble, and Mr. Upton had the dynamo built.

Next the carbon spiral turned up. This was made of thread coated with lampblack and tar. The lamp with this spiral was made like the lamp with the platinum spiral; in fact Edison's lamp has not changed in appearance since, except that for long filaments an elongated glass bulb was and is used to-day. On Oct. 22, 1879, the first lamp with a carbonized paper hoop was made, and on Nov. 4 Edison applied for a patent for a lamp with a carbon filament of high resistance. On Dec. 21, 1879, the New York *Herald* published an account of Edison's successful lamps at the same time these lamps were on exhibition in Menlo Park. Meanwhile Swan made experiments with incandescent lamps with carbon filaments and Maxim was perfecting the hydrocarbon treatment by means of which a hard surface of

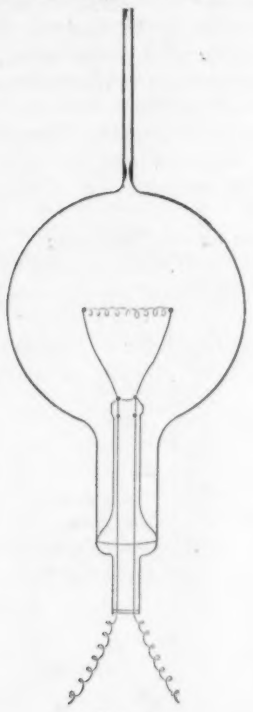


Fig. 5.

carbon is deposited on the baked filament in order to make the filaments of uniform resistance. At first the filaments were fastened to the platinum wires by clamping devices. Edison very early fastened them by depositing copper in the place where the filament was held by the flattened end of the wires. This method, which was used for several years, is now considered worthless because the deposit of copper contains air, which can never be driven out during the process of manufacture because it is impossible to heat the portion with the copper deposit to incandescence. Other inventors fastened the filaments to the wires by putting on mechanically little particles of mixture of finest carbon powder, india ink and sugar solution, etc. Sometimes these little particles are heated to incandescence in a hydrocarbon gas or liquid so as to insure perfect contact. The best method, however, for high resistance filaments is to clamp them in little tubes which form the ends of the wires and then plate them. The filament is placed in hydrocarbon liquid and is cut out of the circuit so that only its ends next to the platinum tubes, one-eighth of an inch long, are rendered incandescent together with the part in the tube. Carbon is deposited only at that point and fills up the little tubes and so "cements" the filament to the wires. Some first enlarge the ends of the filament in a similar way by cutting the filament out of the circuit and depositing carbon on the ends, then the flattened ends of the wire are heated around the enlarged ends of the filament. To get good contact it is also necessary to cement them. The cementing has to be done before treating. There is no air in such an electrolytic deposit of carbon for cementing, because the part where the deposit is made is kept incandescent while the deposition is made, consequently all gases are driven out. The mass of the deposit varies with the current consumed by the lamp. Fig. 8 shows the parts of the modern lamp with filaments variously arranged.

A lamp of a different construction was patented by the author in the latter part of 1880. This lamp consisted of two parts like the modern lamp, but the two parts were not sealed together by fusion nor was the lamp sealed off after the creation of the vacuum. The inside part was ground airtight into the lower open end of the bulb, as gas stopcocks are ground, and the exhausted chamber was closed by turning the inside part about 180 degrees. Alexander Bernstein made hollow carbons in 1881, and later he made lamps with short, thick filaments of carbon for use on arc light circuits in series. These lamps meant a most remarkable step in the progress of the art of incandescent lighting, because they were especially well adapted for high candle power lamps. They are manufactured by various companies, and on an extensive scale by the Bernstein Company, of Boston.

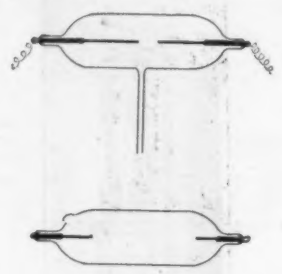


Fig. 6.

As before stated, Maxim was perfecting the processes and methods of the hydrocarbon treatment, and he succeeded well. The first commercial plant of this successful lamp was started November, 1880, in the Equitable Building, 120 Broadway, New York. The successful operation of these lamps with filaments prepared in a hydrocarbon atmosphere proved beyond doubt that the commercial incandescent lamp was invented, a lamp that was uniform in resistance and candle power, and could be manufactured and sold because it was reliable. Of course, practice had to develop details, and skilled labor for manufacturing large numbers had to be educated.

For some years there was not an invention on the lamp which did more than to perfect details or appliances appertaining to the lamp until the structureless filament came. We have seen that the filaments described so far were made of fibrous vegetable material. They possess, after carbonizing, the cellular structure of the plant of which the filament was made, consequently they are very porous before they are treated. (Fig. 9.) The material for structureless filaments is not prepared by nature as the vegetable fibres are; it is a laboratory product. First, a putty-like mass of collodion or gelatine is prepared. This mass is rolled out in thin sheets like paper, which are cut in narrow thin strips and the strips are carbonized. The mass may, by employing a little heat, be spun out into fine threads, which are carbonized. Filaments made of such materials are more uniform throughout than fibrous filaments; they are very hard, and as they have no cellular structure like the fibrous filaments they are not porous, consequently they are more homogenous and in every way far superior to the fibrous filaments. As soon as the advantages as well as the methods of manufacturing these structureless filaments are generally known, then the fibrous high resistance filament will be a thing of the historical past. Only high resistance filaments are made of such masses. They are just as much limited as to voltage as bamboo is. A series lamp cannot be made of either. The exact components of such collodion or gelatine masses are not known, as they are kept factory secrets. The principal manufacturers of structureless filaments are Siemens & Halske, in Berlin, and the De Kohtinsky Company, in Gellnhausen, near Frankfort-on-the-Main. They are made in this country by various companies, the Germania Company, of Boston; the Economic Company, of Boston; the Thwing Company, Chicago; the Buckeye Company, Cleveland, etc. There have been filaments before which could be called structureless. Edison describes a plastic mass of lampblack and tar which was rolled out in threads and carbonized, and it may be wise to point out the difference between the two. The modern structureless filament does not contain a particle of carbon when it is put into the carbonizing furnace; the collodion or gelatine is transformed into carbon in the furnace, while a filament of lampblack and tar contains nothing but carbon in the form of carbon

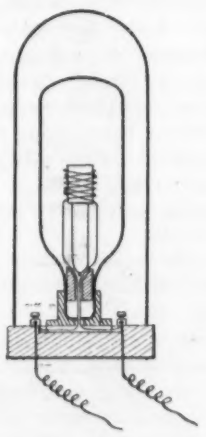


Fig. 7.

powder and a "binder" before it enters the furnace. It is baked only to cement the carbon powder together. The filament of lampblack and tar has never been a practical success, while the modern structureless filament is a great commercial success. Very recently, in 1891, novel processes of treating filaments have been patented by F. G. A. Heller and George Erlewein, of Berlin. By their treatment the filaments are coated with mineral substances, such as chromium, phosphides, iron, etc. Reports about the practical success of these lamps have not yet been published.

We have so far shortly reviewed those inventions which constituted really a step in the progress of the art of the incandescent lamp, and now we will draw conclusions, describing inventions a little more in detail only when it is absolutely necessary. Inventors of appliances pertaining to the lamp will kindly take notice that only the *lamp* is spoken of, and that even the socket is not considered. The various fibrous materials of which filaments are made are not mentioned, because it is all the same in principle whether a fibrous filament is made of cotton or linen thread or silk, of paper, bamboo, india fibre or Piassawa, of Kittul, southern moss, basswood or palmetto, of Maxican hemp, jute, cocoanut, palm or manila; they are all fibrous vegetable materials.

When we look back at the progress in the art up to the appearance of the commercial lamp we find, as stated, that most of the elements of the lamp were known and used for various purposes. There was the all-glass closed chamber with leading-in platinum wires hermetically sealed; there was a luminous bridge of rarefied gases; carbon had been used in vacuo as an incandescent conductor; there were high resistance filaments of platinum for parallel distribution and high vacua were employed before. What patentable features remained to be invented? On what elements could patents be obtained? It looks as if patents could be obtained only on special incandescent conductors and processes for making them, on devices for clamping or fastening filaments to the wires, in fact it looks as if patents, for special processes and mechanical details only, could be obtained but that is not so. The United States government, protecting the inventor, very wisely grants a patent for a combination. It is well known that neither all nor any of

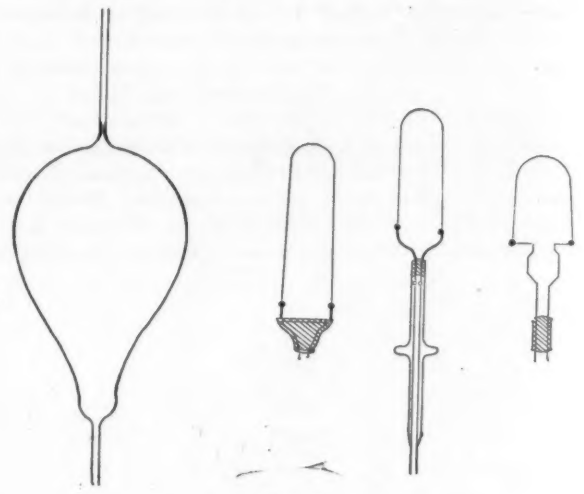


Fig. 8.

the elements or parts of an apparatus or machine need to be novel. If by their combination a new or useful result is achieved, then the combination is novel and as such patentable. Mr. Edison invented a high resistance filament of fibrous material, he had it inclosed in an all-glass chamber and he was granted a patent for the invention Jan. 27, 1880. The first two claims of this patent read as follows:

1. *Claim:* "An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described and secured to metallic wires as set forth."

Can any one concern or company on the strength of this claim control the manufacture of incandescent lamps with high resistance filaments? Certainly not! In the first place, high resistance filaments of other material, of platinum, were used before. Lane-Fox had three patents granted to him, two in October, 1878, and one in March, 1879. This fact is further conceded by highest authority. Judge Wallace, in his decision of July 14, 1891, says: "Electricians knew how to make conductors of high resistance," etc. Can any one on the strength of this claim control the manufacture of incandescent lamps with high resistance carbon filaments? Certainly not! The limits of Edison's invention are shown very clearly by this very first claim of his patent, for only "a filament of carbon of high resistance, 'made as described,'" is claimed, and in order to see what special kind of filament is protected by that claim we have to study the description of it in the specification. The various passages relating to the filament read as follows:

I have discovered that even a cotton thread properly carbonized . . . or if any fibrous vegetable substance . . . that if such fibrous material be rubbed with a plastic compound of lampblack and tar . . . small pieces of this material [lampblack and tar] may be rolled out in the form of wire . . . When fibrous material is used . . . I have carbonized and used cotton and linen-thread, wood splints, paper coiled in various ways, also lampblack, plumbago and carbon in various forms mixed with tar.

As filaments made of lampblack and tar rolled out into wire and then carbonized have not been used in practice, we have to consider here only the filaments made of cotton and linen thread, wood splints, paper and vegetable fibrous

material. In short, only high resistance filaments made of fibrous vegetable material are protected by this claim and no other. The claim speaks of a high resistance carbon filament made as described, and the specification describes a filament made of fibrous vegetable material. The claim does not speak of a low resistance carbon conductor for series lamps to be used on arc light circuits and the specification does not describe such a conductor of low resistance. There is nowhere in this patent a description or intimation of a high resistance filament made of collodion or gelatine, *i. e.*, structureless filament; there is no description or claim of a high resistance filament with mineral coating; there is no description of a carbon filament with a hard coating of structureless carbon as luminous surface; there is only described a high resistance filament of carbon of fibrous vegetable substance, not treated or flashed, a filament left in that porous condition in which it came out of the carbonizing furnace. The court in rendering the decision of July 14, 1891, says: "By making it in a form of extreme tenuity out of such materials as are mentioned in the specification, carbonizing it, and arranging it as he had previously arranged his platinum burner." There is not mentioned any one of the above filaments in the specification, consequently they cannot fall within the first claim of Edison's patent, because they were not made, not described and not claimed by Edison.

Now we have to consider the second claim of that patent. The same reads:

2. *Claim:* "The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air is exhausted, for the purpose set forth."

This is the combination claim. As before stated, a combination, when novel, is patentable even if all parts of the same are old as long as a new and useful result are achieved by it. In this combination, however, there is a new element and an old one. The all-glass closed chamber with leading-in conductors, *i. e.*, platinum wires sealed in the glass, is the old element. It was in use before and was generally known. Geissler tubes had been for 20 years (since 1860) and are to-day a commercial product. The new element was the high resistance filament of carbon made of such materials as are mentioned in the specification, and Edison certainly was entitled to a claim for a combination of that specific filament with an element that was old and public property at that time. He could combine it with an all-glass chamber, and if he could have achieved a new or useful result by combining it with a wood screw, he could have done so, but that combination would not have prevented the public from using screws or all-glass closed chambers which were old, well-known things and public property. The public on the contrary could, as well as Edison, combine these old elements with anything it pleased or saw fit, and we will now see whether such combinations with an all-glass closed chamber were in use before Edison combined his specific filament with it. There was:

(1) The Geissler electric tube. It has embodied in it the combination of a luminous bridge consisting of the residue

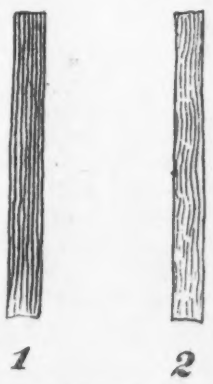


FIG. 10.

of rarefied gases with an all-glass closed chamber having conductors hermetically sealed in so that the currents can be introduced and the vacuum maintained. There was (2) Crookes' radiometer with the incandescent platinum ring. In that radiometer the incandescent conductor (platinum ring) forms a combination with the all-glass closed chamber, which is also provided with the leading-in conductors sealed in hermetically so that the vacuum could be maintained. Whether such combinations were patented or not is immaterial; if not patented, inventors simply made a mistake in not protecting their inventions or scientists generously presented their discoveries to the general public. We have only to ask here, were such combinations made before or not? They were, as we have already seen. Further, (3) a high resistance filament of platinum also forms such a combination with an all-glass chamber. (4) The series carbons of low resistance which are no filaments but short, thick incandescent conductors form also such a combination. (5) The structureless filament of artificial material (collodion or gelatine) forms another combination with the all-glass chamber. (6) The filaments with mineral coatings form such a combination. (7) The filament with a hard coating of structureless carbon as luminous surface also forms the combination. From the previous statements it is clear even to the non-professional that all Edison ever described and protected by the first two claims of his patent of Jan. 27, 1880, is a filament of carbon of high resistance "made as described;" that is, a high resistance carbon filament made of fibrous vegetable material, not treated or flashed, or, as the court expressed it, "out of any such materials as are mentioned in the specification." It would, of course, have been a very different thing if Edison had invented the all-glass closed chamber with the leading-in conductors sealed in hermetically by the fusion of the glass; then the second claim would have prevented anybody from using such a chamber. But that chamber was old and public property and there were also combinations with it before, as is proved by the first two instances referred to above. There is undoubtedly a generic connection between the first and second claim of a patent, and consequently the second,

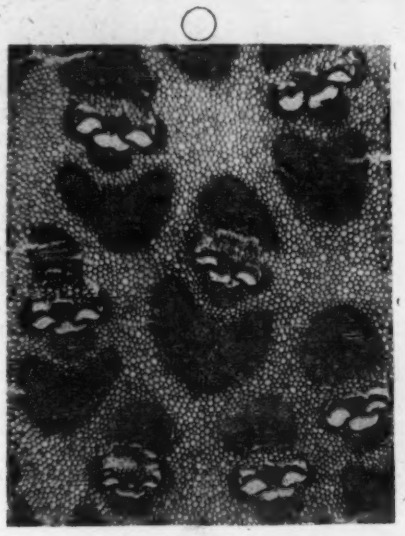


FIG. 9.

or combination claim of Edison's patent of Jan. 27, 1880, quoted above, has reference only to such carbon filaments as are protected by the claim, *i. e.*, filaments out of such materials as are mentioned in the specification. Edison certainly only wanted to protect what he had invented and described in his patent, but this did not include low resistance conductors, etc.

There is another and the most important question to be answered yet, and that question in a nutshell is:

Which of the many progressive steps in the art of incandescent lighting was the step that made the incandescent lamp a commercial success? This question can be answered by physicists and electrical experts only, but as there were no incandescent lamps in the market before 1880, the public had also a chance to form an opinion by observing who first put lamps successfully on the market. The first three installations made outside of laboratories were at Hazel's drug store in New York, on the steamer Columbia, and in the Equitable Building in New York. All of these were made in 1880 by two companies, on the Columbia by the Edison company, the two others by the United States company. The first installation was at Hazel's. The public saw that two companies put lamps on the market at almost the same time, but it was the expert's business to decide which company had the best and most reliable lamp at the time. The Maxim lamps of the United States company had high-resistance filaments prepared in a hydrocarbon atmosphere by the process perfected by Maxim. The luminous surface of these filaments consisted of that hard coating of structureless carbon before mentioned, while Edison's lamps were provided with high resistance carbon filaments of fibrous material left in that porous condition in which they came out of the carbonizing furnace. Prof. G. F. Barker, speaking also for Profs. Draper and Morton, said in the *Evening Post*, Nov. 22, 1880: "There is no doubt in my mind, or in that of Profs. Morton and Draper, as to the value of Mr. Maxim's remarkable discovery. For years I have been an admirer of Edison's search for the true solution of the electric light problem, and I can testify to his unremitting energy and the exhaustive nature of his search, but another man found it." Yes, another man had found it, another man had made the step in the progress of the art which made the lamp a commercial success. The Edison filament left in that porous condition in which it came out of the furnace may fairly be compared with the telephone invented by Reiss, which transmitted musical sound; while the Maxim filament prepared in a hydrocarbon atmosphere may be compared with the Bell telephone, which transmitted articulate speech. It was the true solution of the incandescent lamp problem. This is not an assertion of to-day, as it was recognized in 1880 by the three above named eminent scientists of worldwide reputation. The truth of that statement has been verified by measuremnts made in Dr. Werner Siemens' works in Berlin, the results of which are found in the *Electrotechnische Zeitschrift*, Berlin, November and December, 1885. The results proved that over 30 per cent. more light is produced with the same power with treated filaments than with untreated filaments, and that is a practical, a commercial point. Besides, the treated filaments maintained their efficiency more uniformly during the average lifetime of the lamp than untreated filaments, and this for the very plain reason that the treated filament, with a hard coating of carbon as luminous surface, is by no means so liable to disintegration or volatilization by the mechanical action of the current as is the untreated fibrous filament left in that porous condition in which it comes out of the carbonizing furnace. Fig. 9 shows a cross-section of bamboo, taken from that part of the bamboo from which filaments are cut, magnified so that the little circle represents about one-hundredth part of an inch, that is, about the size in which bamboo is cut for filaments. It shows the pores as well as the places where the substance is densest, and as the little circle represents the size of a filament in the drawing, it is plain that such a filament can be cut from the parts where the material is densest as well as from the part where the pores are largest, or the filament may be cut partly from the densest and partly from the most porous part; in other words, these filaments cannot be of uniform resistance; they have to be treated or flashed, that is, the pores must be filled up by electrolytically decomposing hydrocarbon gas and depositing carbon in the pores until the required resistance is obtained, and as the maker has it in his power to stop the deposition of carbon when he pleases by simply turning off the current at the proper moment, it is possible to make filaments of any desired resistance uniform and reliable, while we have no control of the filament while it is baked in the furnace, nor can we cut them while seen under the microscope so as to get through all of the densest portion of the material. The superiority of the structureless filament made of collodion or gelatine, made of a uniform, homogeneous mass, suggests itself after these explanations. That treating process was never patented in Germany, but it was patented by Sawyer & Man in Great Britain (Pat. No. 4,847, in 1878). The patent was bought by the Edison-Swan United Electric Light Company, Ltd., and it was sustained in court in a suit of that company against Woodhouse & Rawson, of London, in 1886. Justice Butt said: "The process by which the desired result is obtained is, to my mind, one of singular beauty and efficacy." If a filament is treated to a certain extent, if it is much treated, it can be distinguished from an untreated filament by the naked eye of any experienced person. The smooth, silvery, rather metallic looking surface indicates the treating, while the untreated filament looks like carbon. If, however, it is treated only a small amount, it is hard to say whether the filament was treated or not; but in any case there is on the filament one or more spots where the most carbon has been deposited, and these have a smooth, shiny, surface, and if that part is brought under a microscope next to a part of an untreated filament, the microscope will reveal the fact that the filament is treated. Fig. 10 represents an untreated and a treated filament. The untreated under the microscope looks black like coal and appears smooth when examined with a lens magnifying about fifty times its diameter, while the treated filament has in proper light a silvery appearance and looks as if it had a number of silvery strips on its surface.

Fig. 11 represents heated filaments as seen under the microscope by a lens magnifying about 50 times the diameter. All fine pieces are made from one filament which had at the start 450 ohms resistance. The thinnest was treated down to 300 ohms, then a piece was broken off and the rest treated to 200 ohms, and so forth to 100 ohms, to 50 ohms, and the last to 25 ohms. All five were mounted on one glass, so that they can be seen at once under the

FIG. 11.

microscope, where they present the appearance in the cut. With reference to volatilization, it may be stated here that it is an erroneous opinion held by many that volatilization is due to that trace of oxygen contained in that trace of air which cannot be removed by exhaustion. That oxygen is said to combine with carbon, forming carbonic acid gas, and this carbonic acid gas is said to be decomposed on the inside glass wall, leaving the carbon on the inside surface of the glass; then the oxygen is said to return to act on a new particle of carbon, and so forth. In the first place, carbonic acid gas is never formed when oxygen and carbon act upon each other when carbon is present so much in excess. Under such conditions, as every chemist knows, only carbon oxide is formed, and further what chemical power is there on the glass walls to decompose carbonic acid gas or carbon oxide? There is none. Volatilization is only due to that mechanical power of nature here employed. It is due solely to the mechanical action of the current. The word "Zerstäubung," that is, throwing off as dust, explains exactly what is done, and the softer a filament, the more it is liable to volatilization, and the harder it is, the less liable it is to this action. This shows, too, the importance of the treating process, and there is, so far as my personal knowledge goes, not one lamp factory in this country or in Europe that does

not treat its filaments at all. Edison, however, says that he does not treat the lamp filaments. The carbonizing in the furnace alone and the "recarbonization by the current," without the aid of some hydrocarbon gas, will never produce filaments of uniform resistance, especially not of fibrous materials. This is the general experience, but we must accept that rather singular statement that Edison filaments are not treated. The very best filaments of to-day, the structureless filaments made of collodion or gelatine, which are more homogeneous than fibrous filaments, do not come out of the furnace of uniform resistance. No matter how carefully they are made and cut into exact length before being mounted, no matter how carefully they are selected with the micrometeras to exact thickness, that is uniform sectional area, they do not come nearer than within 15–20 volts when burned at uniform candle-power, and that with an experience and skill of ten years in the art.

There is one passage in the decision of July 14, 1891—Edison Electric Light Company *versus* The United States Electric Lighting Company—which I would like to quote. The court says: "The claim is not limited to a carbon filament made of non-fibrous material." It is clear to the professional that the non-fibrous filament in question is the filament made by Edison and described by him. In the specification of the patent in suit, he describes a filament made of lampblack and tar rolled out into wire and then carbonized. It has certainly no reference to the modern structureless filament, which, as we have seen, is principally ready before it enters the carbonizing furnace, and which is a great commercial success, while the other has never proved to be practical.

In conclusion it is fair to say that it is not more than right that an inventor shall reap the fruits of his labor. But we must not go too far in the other direction and concede to one inventor the fruits of the labors of thousand of other inventors who have done less, just as much or more, as the case may be, in the same line, especially when the step in the progress of the art made by that one inventor is not the step that brought the true solution of the problem, that made the lamp a commercial success.

There has been said a great deal about the perfection of a complete system of incandescent lighting. The most important thing after the lamp is certainly the dynamo. What Edison thought about dynamos before 1879 when he began to experiment in that direction he revealed to the world in his United States patent of Aug. 5, 1879, by the invention of his tuning fork dynamo. At a later date Mr. Upton built the Siemens armature, perhaps because measurements made in England (Preece, "Parliamentary Report" May 2, 1879) had proved that the Siemens machine was the best, and that the Gramme machine came very closely to it; perhaps because Mr. Upton had been for a year a student in Berlin under the celebrated Helmholz, where he had an excellent chance to study the Siemens machine, and it is an open question which everyone may answer for himself, whether the world would not have been surprised with a re-invention of the Gramme ring if Mr. Upton by chance had studied in Paris under Fontaine.

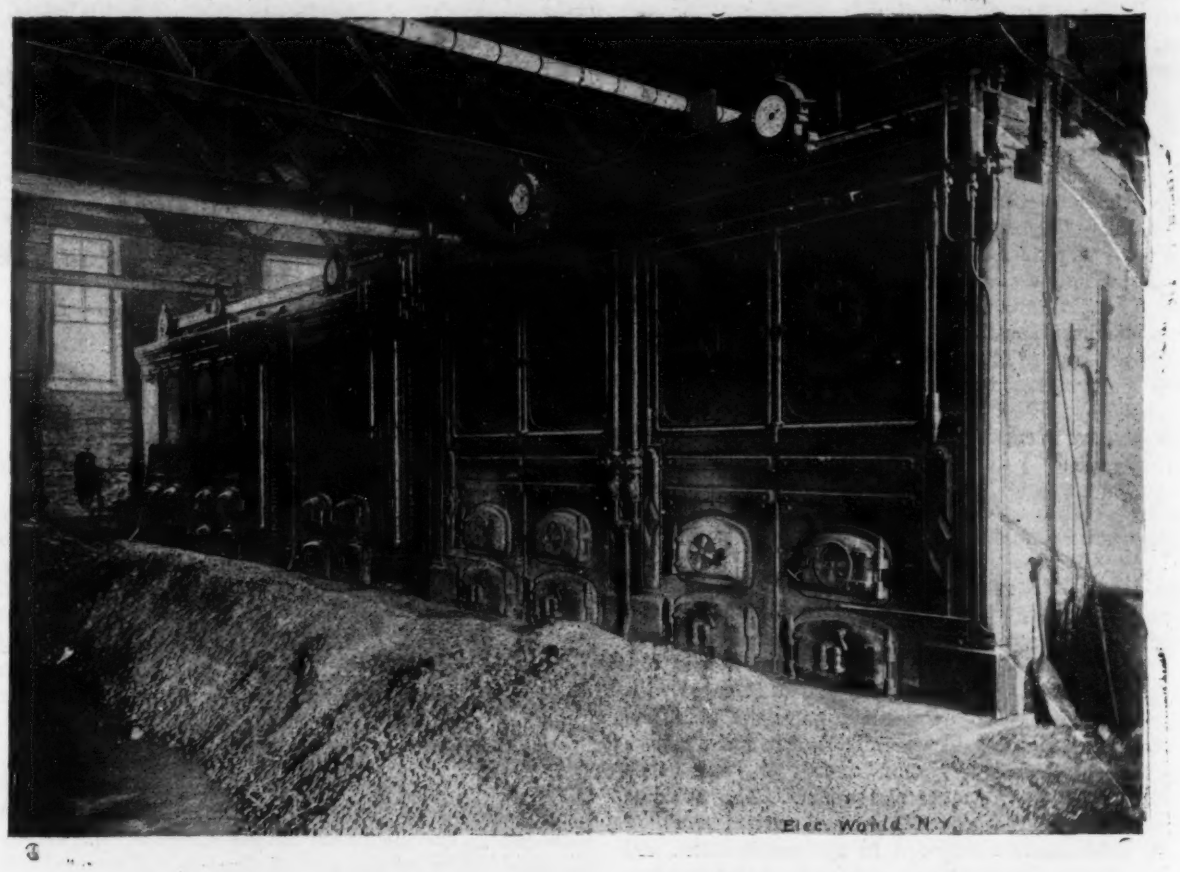
Arc Lighting in Toronto, Canada.

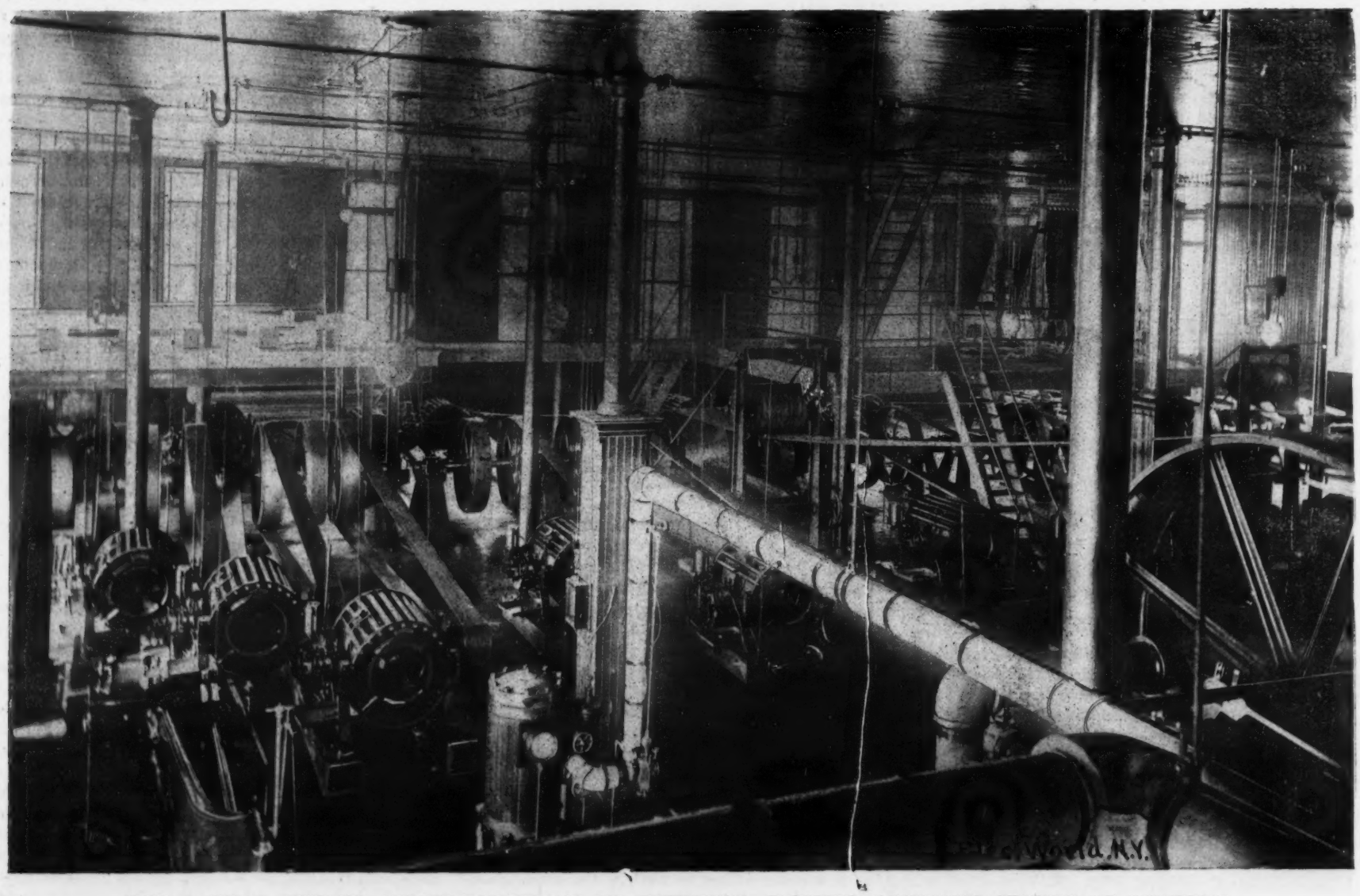
The Toronto Electric Light Company was incorporated in September, 1883, and since that date its business has steadily grown and extended, until now it occupies the proud position, not only of being the only arc light company in Toronto, but of lighting the entire city from the Don to the Humber.

When first started the company only furnished a few commercial lights, but in 1884 it secured the contract for lighting Yonge, King, and part of Queen streets. The original station was situated on Sherbourne street, and contained Excelsior and Thomson-Houston dynamos driven to a large extent by high speed engines.

The present station is situated on the water front at the foot of Scot street. The boiler house is located close to the water and in the rear of the station proper, and contains 13 boilers of 100-h. p. each, built by the Polson Iron Works Company of Toronto. Next to the boiler house comes the rear engine room, which extends the whole distance across the station and contains two pairs of high pressure condensing engines of 500 h. p. each, and one pair of compound condensing engines of 500 h. p., all of the Brown-Corliss type and built by the Polson company. The flywheels of these engines weigh over 10 tons each and are accurately balanced. Close to the engines stand the three Worthington steam pumps for feeding the boilers. The shafting is under the floor of the dynamo room, which is situated immediately in front of the rear engine room but in no way divided from it.

The floor of the dynamo room is raised about eight feet above the ground floor so as to admit of ample room for the shafting beneath. There are in all 48 dynamos having a united capacity of about 1,700 arc lights of 2,000 c. p.





FIGS. 1 AND 2.—DYNAMO AND BOILER ROOMS OF THE ROYAL ELECTRIC COMPANY'S STATION AT MONTREAL.

each. These dynamos supply about 1,500 street lights and about 200 commercial lights.

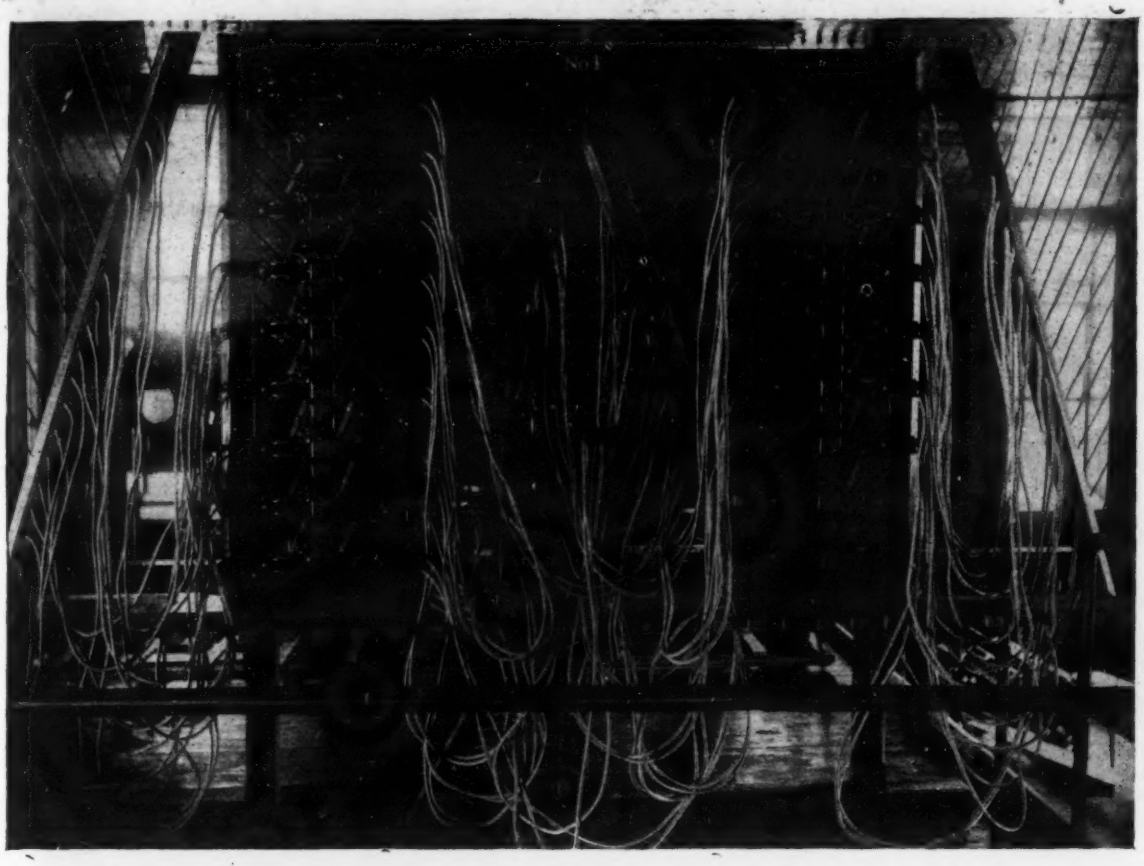
In front of the dynamo room is the front engine room, which contains one pair of 500-h. p. compound condensing engines, the same as those in the rear engine room, and in front of these is the switchboard and the offices of the company. Nearly all the dynamos and lamps in use have been manufactured on the premises, the company's shops being fitted up with all the latest and most improved

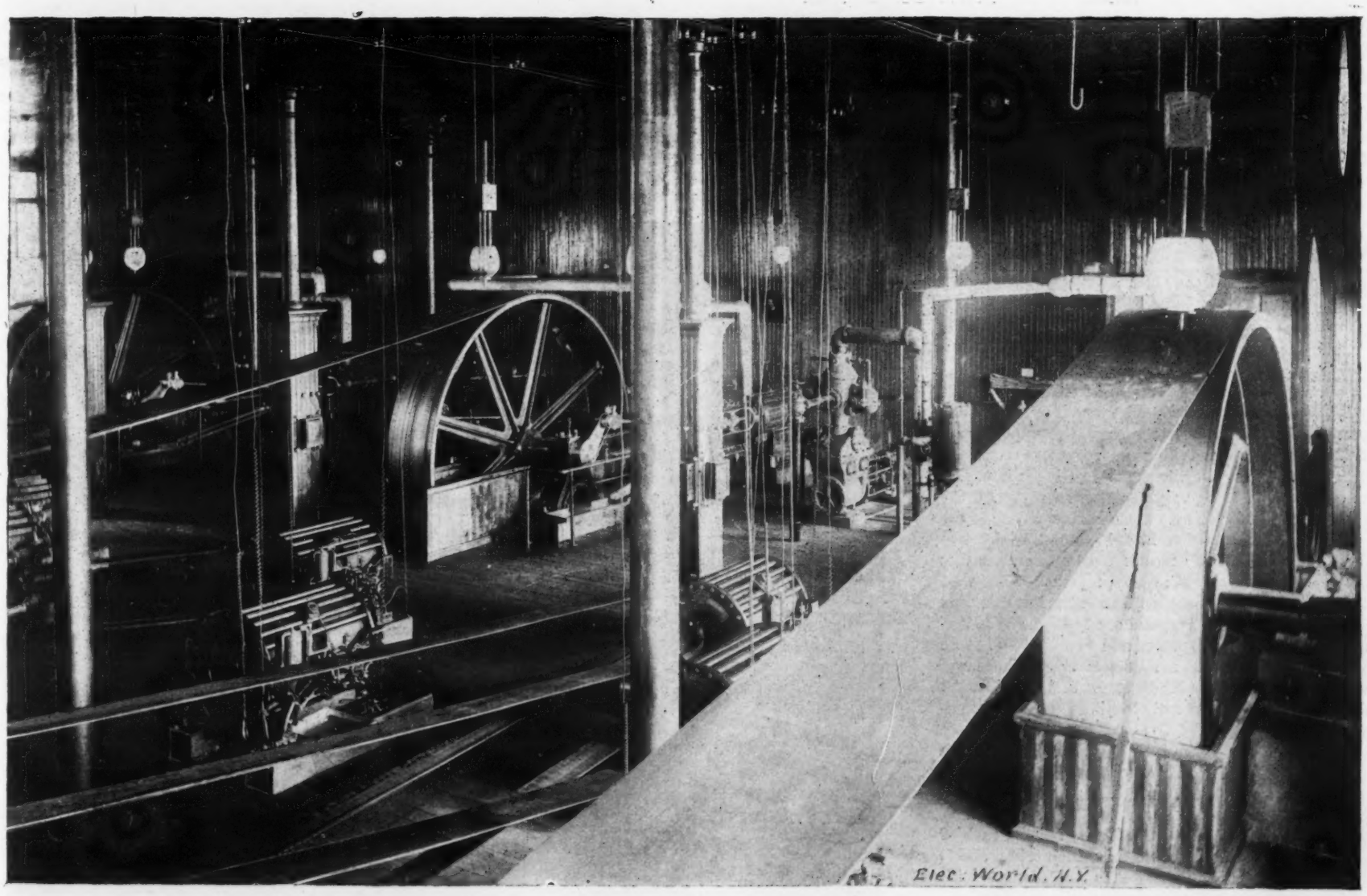
Lighting Station of the Royal Electric Company at Montreal.

Perhaps the most active electrical organization in Canada is the Royal Electric Company, of Montreal, whose great central station we illustrate. This company is the Canadian licensee of the Thomson-Houston Electric Company and manufactures apparatus under the Thomson-Houston patents; the machines therefore have a particularly familiar look, and to all intents and purposes are identical with those with which our readers are familiar. The Royal Electric Company began business in Canada in 1883, at first in a very small way, but by energetic management it has kept abreast of the times and has built up a very large industry. On their system a considerable number of central stations have been erected and large quantities of apparatus have been supplied in all parts of the Dominion. Their combined station and works, on Wellington street, near the Lachine canal, contains a large central station plant, while the East End station, which we illustrate, is the largest in the Dominion. This latter is a stone structure one story high, surmounted by a wire tower and a stack 125 feet high. This arrangement of the station makes the establishment of proper foundations for the machines very easy, and results in an exceedingly well arranged and efficient station. The plant is used exclusively for municipal lighting, and has a full capacity of 1,200 arc lights; it is nearly full loaded all the time, and is shortly to be increased.

The general arrangement of the station is admirably shown in Fig. 6. A heavy wall separates the boiler room from the engine and dynamo room, and the engines are belted directly to the long line shaft, divided into sections by means of friction clutches, to permit a ready transfer of load from one engine to another. The dynamos are arranged on both sides of this line shaft and their respective driving pulleys are connected to it by friction clutches, so that any of the machines can be thrown in or out of action whenever necessary. Fig. 1 shows the dynamo room in its general arrangement. There are 22 50-light arc dynamos of the Royal Electric Company's make of the Thomson-Houston pattern. The switchboard, situated on the wall at the end of the line shaft and shown in Fig. 3, is well arranged and has a capacity for handling 34 circuits; 22 are now installed, the longest of them being about 10 miles. All enter the building through the wire tower and are provided with lightning arresters on both legs. These are all banked in the tower, as shown in Fig. 5. The engines are three in number. Two of them are double cylinder machines of Polson make, having each a pair of cylinders 16 inches in diameter and 42 inches stroke, with a capacity of 350 h. p. These are, of course, slow speed engines, according to the almost universal Canadian practice. The third engine is a tandem compound condensing engine of 400 h. p., having cylinders 18 and 36 inches in diameter respectively and 42 inches stroke. For supplying the condenser and feed water a well is situated in the engine room 65 feet deep and 300 feet from the river. This furnishes at all times an abundant supply of pure water. The engine room is shown in Fig. 4 and the adjoining boiler room in Fig. 2. This latter now contains five Babcock & Wilcox boilers, three of them of 200 h. p. capacity each, the other two of 250 h. p. each, making an aggregate of 1,150 h. p. available. This capacity can be readily increased, as will shortly be done to accommodate additions to the plant.

The officers of the Royal Electric Company, that operates this plant under a municipal contract of five years from 1889, are Hon. J. R. Thibaudeau, president; Mr. C. W. Hagar, general manager, and Mr. Fred. Thomson, chief electrician. Such stations as this is evidence enough that our Canadian friends are by no means behind hand in the matter of electric lighting. Ten years ago there was not a single plant in Canada, and the first electric lights seen in Montreal were a few Thomson-Houston arc lights placed on exhibition by the Thomson-Houston Electric Company of Canada, afterwards organized into the Royal Electric





FIGS. 3 AND 4.—SWITCHBOARD AND ENGINE ROOM OF THE ROYAL ELECTRIC COMPANY'S STATION AT MONTREAL.

machinery for the manufacture of electrical apparatus. The company has now in use in the streets of the city about 250 miles of wire, but a large portion of this will shortly be placed underground, as the company's energetic manager, Mr. J. J. Wright, deems it best to commence this work before being asked to do so by the city, and thus maintain the popularity and efficiency of the service.

The present officers of the company are: A. H. Campbell, president; W. H. Howland, vice-president; Samuel Trees, treasurer; H. M. Pellatt, secretary; J. J. Wright, manager.

Company. The first incandescent plants were private installations made in the city of Montreal. One was in St. Lawrence Hall, the other in the Bank of Montreal, and the lamps employed were the old Maxim. In St. Lawrence Hall, so crude were the methods employed, that only one lead was carried from the dynamo to the lamps, the return being via gas and water pipes.

From this small beginning the industry has grown until there are now something like 1,400 arcs and 75,000 incandescent lamps in use. Electricians from the States will note few unusual features in the kind of apparatus used. The bulk of the lighting is done by the system of the Royal Electric Company. The Ball system has been pretty thoroughly exploited in Canada and operates close on to 4,000 arc lights. The Edison company has kept a considerable foothold for incandescent work. A considerable number of arc lights are operated from Reliance machines, and the remaining total output is divided between a number of systems more or less familiar to our readers. In the present issue several other of the important central stations in Canada are described and a comparison of them with the large Montreal plant cannot fail to prove instructive.

Electric Lighting at Hamilton, Ont.

The station of the Hamilton Light and Power Company is situated on the corner of King and Catherine streets, Hamilton, Ont. The building is of brick, having 85 feet frontage on King street and extending 180 feet back to the alley on Catherine street. The situation is in the eastern end of the business section and exactly in the centre of the city, thus rendering it comparatively easy to reach all points in the city with the incandescent circuits.

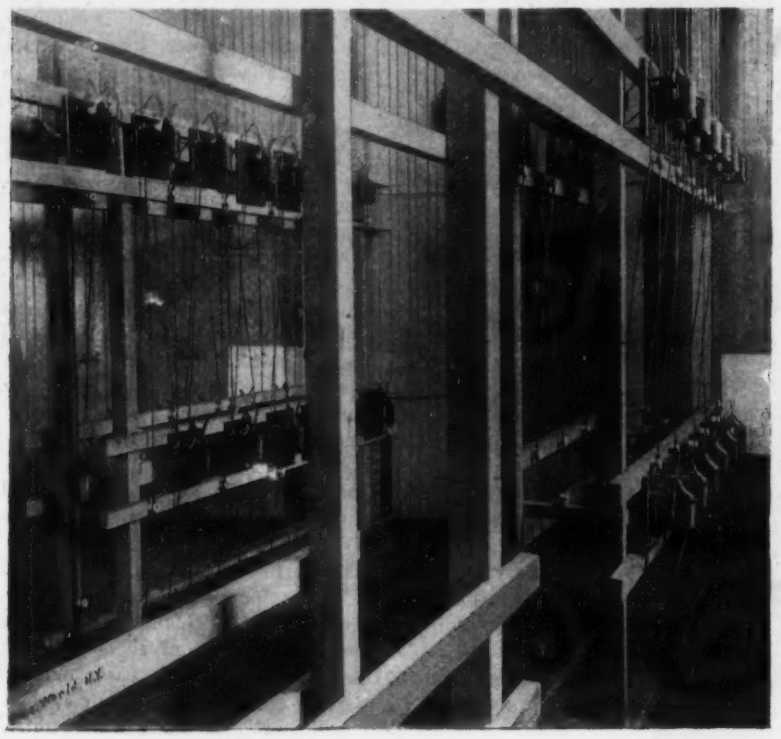
The whole of the lower floor and basement of the building is occupied by the lighting company, the upper floors being rented out with power to small manufacturers. In the front of the building are the offices, testing room and repair shop, the latter being very neatly fitted up. In the rear of the offices and facing on Catherine street is the dynamo room, containing five 50-light, two 35-light, two 25-light and two 14-light Thomson-Houston arc dynamos made by the Royal Electric Company, together with wall regulators, switchboard, ammeter, etc. The incandescent plant consists of one 1,500-light, and one 500-light Westinghouse alternating current dynamos and two exciters. The incandescent switchboard is a model of convenience and ingenuity, and reflects great credit on its designer, Mr. W. J. Clarke, who until very recently has been general manager of the company. All the dynamos except one are run from a single line shaft extending almost the entire length of the room. This shaft is divided in the middle, and each end is connected by means of a clutch to the counter shaft of one of the large engines.

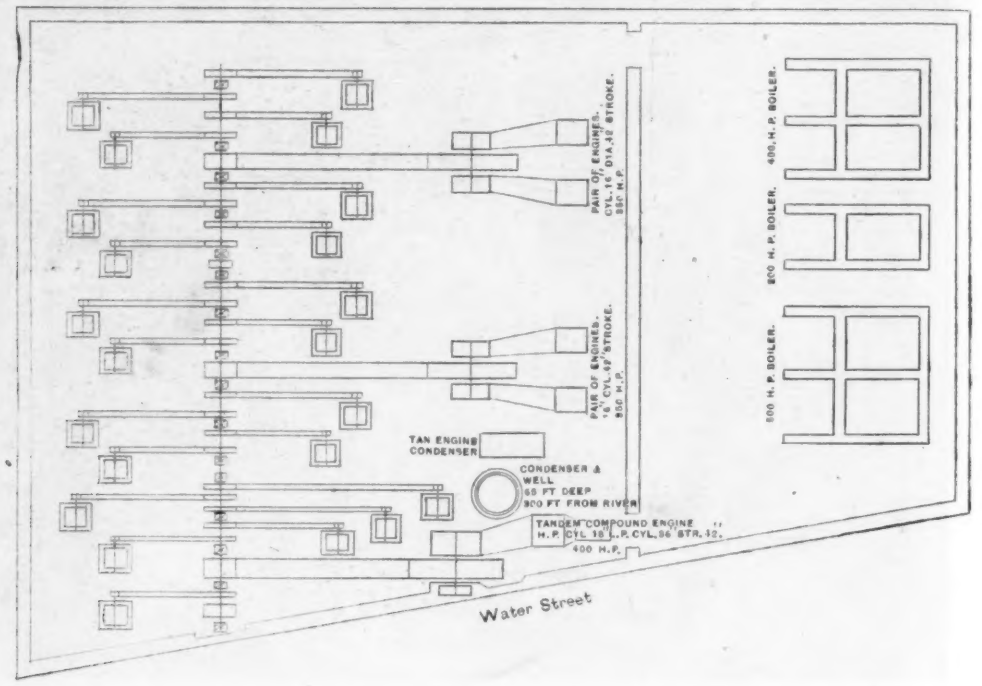
The steam plant consists of three Kelley boilers, each of which has a 60-inch shell with 78 three-inch tubes, and is 14 feet long; two Beckett Engine Company's boilers with 60-inch shells and 78 three-inch tubes, 11 feet long, and two Goldie & McCullough boilers with 68-inch shells and 98 three-inch tubes, 14 feet long. All these boilers are situated directly east of the dynamo room and between the two large engines. There are in all three engines. One of 65 h. p. Westinghouse pattern drives the 500-light alternator and exciter, and one 300-h. p. Wheelock engine with a 20 × 46-inch cylinder drives each end of the line shaft, from which all the other dynamos are driven.

There are in all 310 street arc lights, about 50 private arc lights and 2,000 incandescent lights, so that the capacity of the present station is entirely taken up and a much larger station will shortly be built in the rear of the present one. The efficiency of the staff and of the service rendered by the company leaves nothing to be desired, and considering the fact that the station has been extending so rapidly it is as near a model as it is possible for it to be under the circumstances. On the resignation of Mr. Clarke, Mr. D. Thomson, brother of Prof. Elihu Thomson, of Lynn, has been appointed general manager. Mr. Thomson has for some years been superintendent for the Royal Electric Company, of Montreal, and has had a very large electrical experience.

Electric Lighting in Victoria, British Columbia.

Victoria is the capital and oldest city in British Columbia, and is situated on a slightly elevated plateau near the southern extremity of Vancouver Island. It was founded in 1847, and has a population of 18,000, and of this number 6,000 are Chinese.

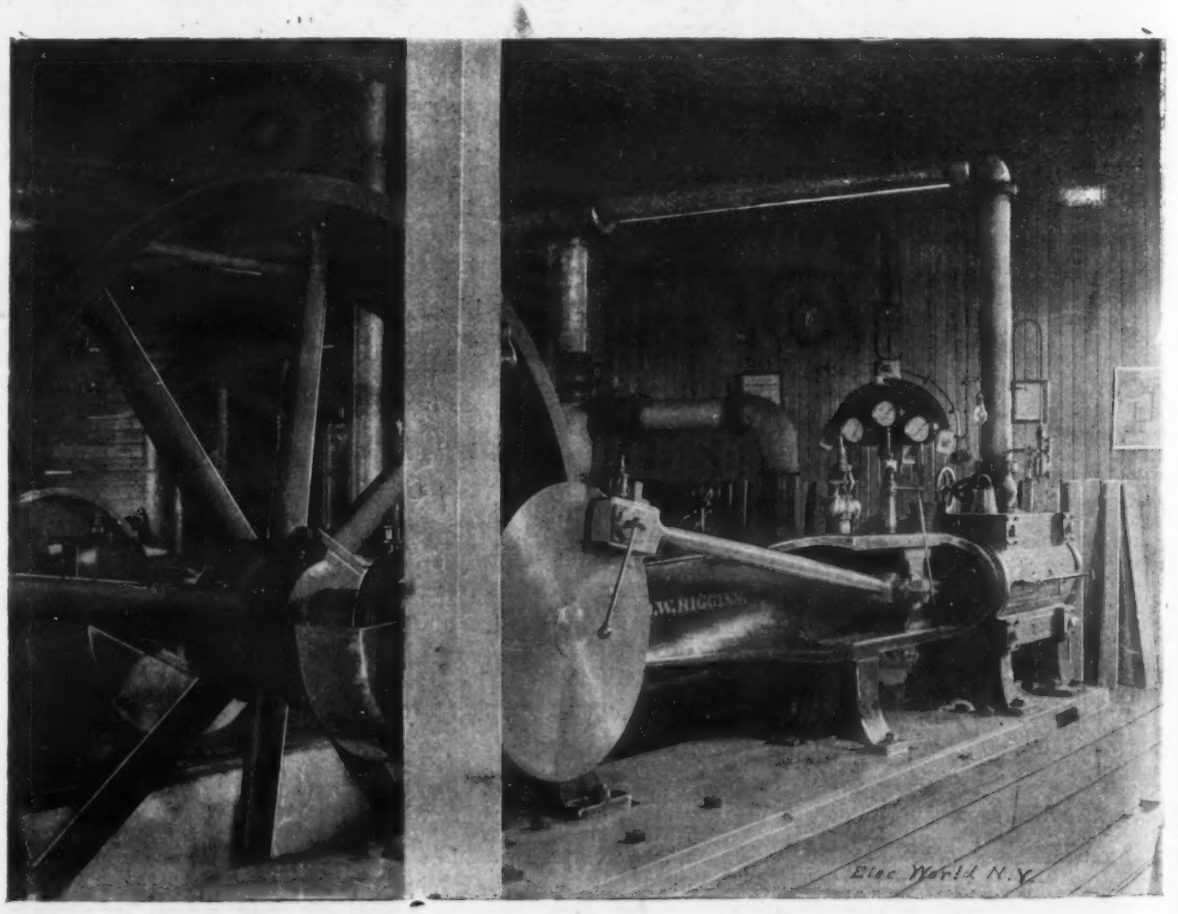



PAIR OF ENGINES. 16" CYL. 24" STROKE. 250 H.P.
TAN ENGINE CONDENSER
CONDENSER & WELL 60 FT DEEP 300 FT FROM RIVER
TANDEM COMPOUND ENGINE H.P. CYL 18" L.P. CYL. 36" STR. 42. 400 H.P.
400 H.P. BOILER.
500 H.P. BOILER.
Water Street

FIGS. 5 AND 6.—LIGHTNING ARRESTERS AND PLAN OF STATION, ROYAL ELECTRIC COMPANY, MONTREAL.

The first incandescent central station in Canada was started in Victoria in January, 1887, by the Victoria Electric Company. The plant consisted of two No. 6 Edison machines, driven by an Armington & Sims 9×9 engine. Two years later this plant was enlarged by the addition of two No. 10 Edison machines, one 50-light Ball arc machine, and one 12×12 Armington & Sims engine. Mr. Hutchinson, of Sherbrooke, Canada, was sent out by the Edison company to carry out the work of installing a new plant and to reconstruct the old one. The work was carried through successfully, and as will be seen from the accompanying illustrations the plant is just about as compact as it could be. Besides the usual equipment of engines and boilers, the station contains all necessary ammeters, voltmeters, a standardizing voltmeter, and six comparative indicators, one for each of the six feeders. The plant is now over taxed and an extension is being made, but this time of a very radical nature. The company finding it necessary to get to the water front, has ordered two No. 32 Edison machines and two 125-h. p. McIntosh & Seymour tandem compound engines, all of which will be placed in the new station. The circuits will also be extended one and a half miles so as to take in almost all of the city. The system will be so arranged that uniform pressure can be maintained on the feeders at any given point. Up to last year the company paid no dividend, but under the careful management of Mr. Baker, the managing director, and Mr. Hutchinson, the superintendent, a dividend at the rate of 10 per cent. per annum has been paid this year. The largest consumers are the St. Andrew's Church, 160 lights; St. Andrew's Roman Catholic Cathedral, 355, and the Club Theatre, 75.

The National Electric Tramway and Lighting Company, Limited, started its first car on the 26th of February, 1890; some time previous to this a contract was placed with the Thomson-Houston Electric Company for a full railroad equipment. The plant then consisted of one 80 h. p. generator, four cars and five miles of line, the engine and boilers being built by the Albion Iron Works. The service at present, with two branch lines added, requires 10 cars, six of which were built at St. Catherines, Ontario, and four by the St. Louis Car Company.



ENGINE ROOM OF THE NATIONAL ELECTRIC TRAMWAY AND LIGHTING COMPANY, VICTORIA, B. C.

As the first engine and generator were considerably overloaded an order was placed with the Albion Iron Works for a cross compound condensing engine of 300 h. p., and with the Thomson-Houston Electric Company for two 80-h. p. generators. These were put in operation on the 17th of January of this year, and have done good service ever since. At this time the station was practically rebuilt.

The foundations for the engines and generators are

composed of stone chips and cement. The engine drives a line of shafting by means of patent rope driving gear. Hill clutches are used throughout and are giving good satisfaction. Of the three generators two are in use, one being kept as a relay. The station also contains two Thomson-Houston alternating current machines driven from the countershaft by the new engine and by the old one when the railroad engine is shut down. Four new Edison single reduction motors have been ordered to replace those originally supplied with the cars.

As the company was unable, owing to financial difficulties, to put in a lighting plant of its own it sold the right for two years to Mr. Osgood, of Seattle, agent for the Thomson-Houston company, for $300 per month, the tramway company to supply him with whatever power was required and agreeing also to buy the plant at the end of the two years. The plant consists of two "35 A" Thomson-Houston alternating current dynamos of 650-light capacity each, driven by Schieren perforated belts from the countershaft. At present one machine only is in operation, the other being available in case of break down, or an extra demand for lights. The wire used throughout the installation is of the best quality, all of it being supplied by the Edison company through its Toronto office. The plant is operated on the meter system, each consumer being supplied with a Thomson wattmeter. All renewals of lamps are made free to the consumer. Among the largest consumers are the Government buildings, 300 lights; Methodist church, 200; Christ church cathedral, 50, and the *Colonist* office, 110. The service given by the company is very satisfactory and the number of lights in circuit is rapidly increasing, the demand being especially good for residence lighting.

The street lighting is carried on by the city authorities, the plant consisting of two Ball and two Brush machines. To this plant two 50-light Ball machines are being added. Masts and poles are used, the masts being from 50 to 150 feet high, and each mast being fitted with from two to five lamps. The cost to the city for 75 2,000-c. p. lamps, nine 4,000-c. p. and six of 3,000 c. p., is reported as follows: Wages $5,000, coal $2,500, wire and carbons $1,500, sundries $3,000, making a total of $15,000. Mr. R. B. McMicking is the city electrician and is also agent for the Ball Electric Manufacturing Company, of Toronto. The city recently made an effort to purchase the gas works and the two electric companies now in operation, but negotiations with these concerns did not have the desired result.

At Esquimalt the Dry Dock Company has a No. 4 Edison machine driven by an Armington & Sims engine. The W. P. Sayward saw mill has a 75-light Crompton machine, and the flour and rice mill a similar machine, both installed by Messrs. Keegans & Milne, of Montreal. The firm of Johnson, Walker & Flett has a 50-light Jones machine in use, the Albion Iron Works a 25-light arc Brush machine and the steamer Islander a 150-light Paterson & Cooper English machine.

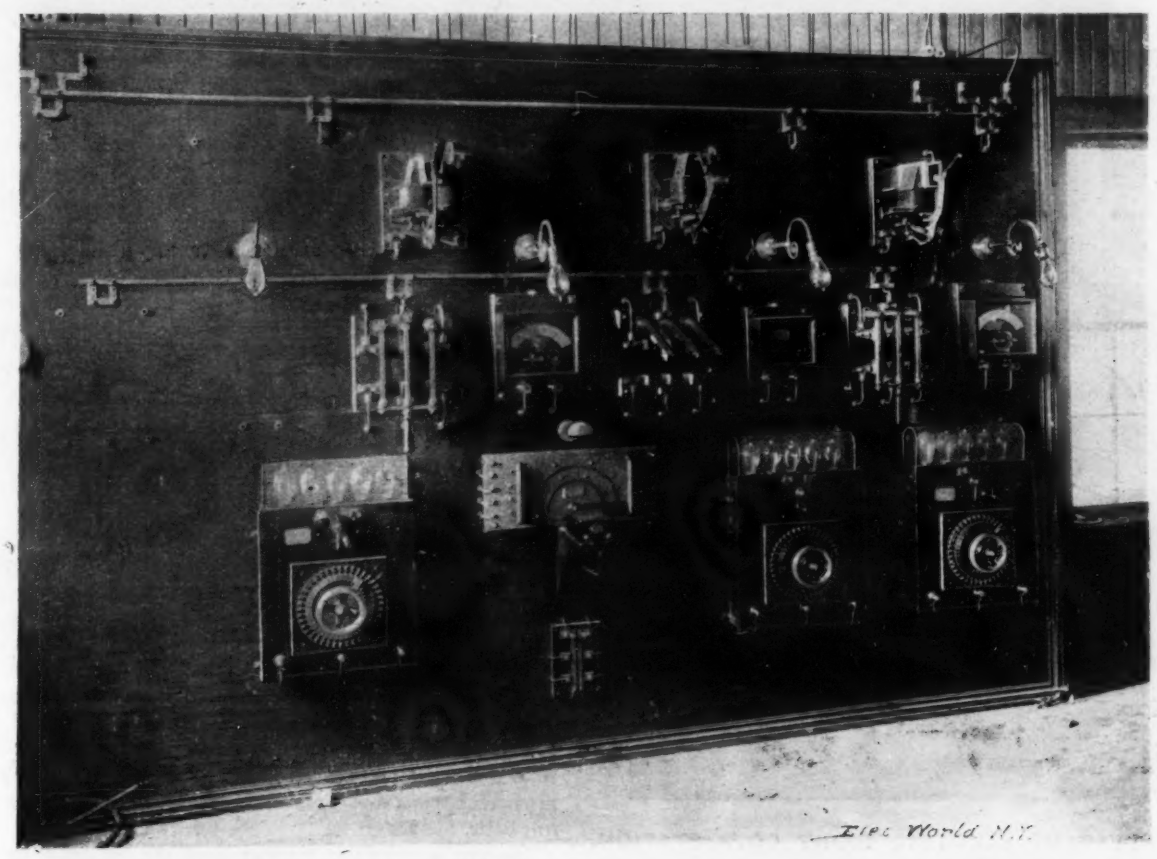
In October of last year the City Council of New Westminster appropriated $50,000 for the purpose of lighting the streets of the city and for establishing a plant for the supplying of both arc and incandescent lights to the public. As yet they have accomplished their object only as regards the street lighting, as the gas company has stepped in and shown that a charter granted to it by the city stipulates that the city cannot carry out the intention of supplying lights for public use.

The lighting of the streets is accomplished by a plant of the Thomson-Houston system, the arc lamps being of 2,000 c. p. The incandescent lighting is to be done by the Thomson-Houston alternating machines, one of which, a No. 35 A, being in position. This is driven by a Corliss engine furnished by J. English & Company, of Toronto.

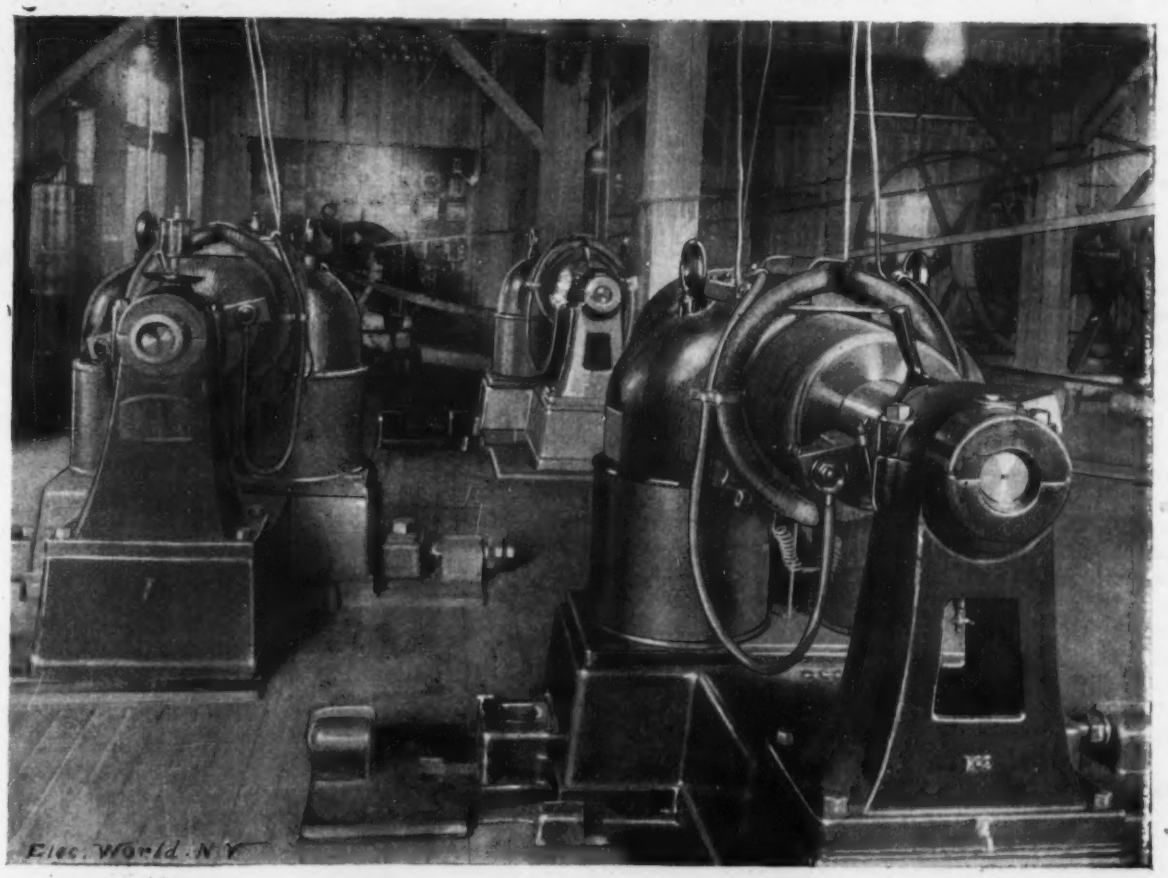
The New Westminster Street Railway Company has its tracks well under way, and cars will soon be in operation. Electric motors of the Edison system are used. Six cars have been ordered. The motors will be of 20 h. p. each.

The Brunette Sawmill Company, of New Westminster, has recently installed a 300-light Crompton machine, furnished by Messrs. Keegans & Milne, of Montreal.

Nanaimo is the fourth city in size in the province and is situated on the east coast of Vancouver Island about 40 miles from Vancouver. The present electric light plant consists of one No. 10 Edison dynamo, and one 50-light Ball machine, but arrangements are being made to put in a second Edison machine and to operate the plant on the three-wire system. While these changes are being made the station will also be fitted up for the supplying of power for railway purposes, as the Edison company has secured the contract to build a road and supply the cars. Mr. Shaw is the owner of the present plant, but in future it will be known as the National Electric Light and Railroad Company. The city has just closed a contract with Mr. Anderson of Vancouver, the agent of the Edison company, for a plant of 75 arc lamps and a complete plant for the operation of them, including engines, boilers and dynamos, etc. The Armington & Sims engine will be used.



SWITCHBOARD OFITHE NATIONAL ELECTRIC TRAMWAY AND LIGHTING STATION AT VICTORIA.



DYNAMO ROOM OF THE VICTORIA (B. C.) LIGHTING PLANT.

Liege University.*

It is a curious fact, says the Paris correspondent of the *Standard*, that one of the first schools for teaching the science and applications of electricity to industry was opened at the University of Liège, the town to which the poor joiner's lad Gramme, born in 1826, at Jehay Bodegnée, Belgium, came to work, and at the same time to study geometry and mathematics at the free classes for adults. Had it not been for the knowledge he thus acquired at Liège he would never have been able to understand the theories of the Italian *savant* Paccinotti, and to apply them in an invention which has made his name celebrated in every civilized country. One of the first schools of electricity was opened in 1883 at the same university. The initiative in this creation was taken by M. Montefiore-Levi, the Belgian senator and philanthropist, who is almost as well known throughout Europe and America as in his own country. In endowing the University of Liège with an electro-technical section, M. Montefiore-Levi had the double object in view of opening up a new and lucrative career to the students of the university where he himself had been educated, and of encouraging the electrical industries by facilitating the recruiting of their *personnel*, who require to have a thorough technical knowledge of electricity. He commenced by placing a sum of 100,000 francs at the disposal of the government for the preliminary cost of the purchase of the necessary instruments and materials, but since then he has gone on giving annually larger amounts, in proportion as the needs of the new school grew with its rapid development. The government, on its side, furnished the buildings, but as the University of Liège was being rebuilt the electrical section was at first housed in modern constructions in the courtyard of the main buildings. This year it has been allotted a thoroughly appropriate building containing workshops and laboratories. It is, indeed, so spacious that it has been possible to provide a separate laboratory for every two students of electricity. On this occasion M. Montefiore-Levi has given 150,000 francs to provide the workshops and laboratories with all the necessary instruments and materials to enable students to make, not only the experiments requisite for their studies, but also experiments for new discoveries and inventions. The practical utility of the institution has been already amply demonstrated. All the students who have in any way distinguished themselves at it are sought after by the chiefs of the electrical industry. It would also be easy to give a long list of the useful inventions made by former pupils; but, as imitation constitutes the most valuable praise, it will suffice to note that the Italian government has followed the example set at Liège by creating a similar electrical school at the University of Milan, and by placing Signor Zurini, one of the former students of the Liège school, at its head. But though the electrical section of the Liège University owes its existence to M. Montefiore-Levi, its success and rapid development have been due to the untiring exertions of Prof. Eric Gérard, who has presided over it ever since it was created.

M. Eric Gérard is a distinguished electrician, well known throughout Europe as having been the delegate of the Belgian government at almost all the electrical congresses that have been held for many years past. He is a comparatively young man, having been born at Liège in 1856. When 22 years of age, he left the University of Liège and

*From the *Electrical Engineer* (London).

completed his electrical studies at the Belgian Ecole Supérieure de Télégraphie. M. Gérard has also written largely on electrical science.

Incandescent Lighting in Toronto.

The Toronto Incandescent Electric Light Company's station, which is illustrated in the accompanying cuts, has been in operation only about 18 months. The company was organized in 1889 with a subscribed capital of $125,000. The station was commenced in the fall of that year and at the same time the company began to lay its underground mains. The work was completed in February, 1890, and on the 15th of that month the first trial was made of the working of the station. On March 1st the company began to furnish current regularly to consumers and since that date the station has been in continuous operation. The first equipment of the plant included three horizontal tubular boilers and two Straight Line engines, each of the latter being of 165 h. p., and two pairs of Edison No. 20 dynamos. From this beginning the plant has grown until at the present time the equipment consists of seven 60-inch boilers 16 feet long, two straight line engines and three of the Armington & Sims type, having an aggregate capacity of 1,000 h. p., and six No. 20 and four No. 32 Edison dynamos. The station building is of brick and stone, substantially built and well finished, has a frontage of 54 feet and extends back to a depth of 170 feet.

THE ELECTRICAL GALLERY OF THE TORONTO INCANDESCENT ELECTRIC LIGHT CO.'S STATION.

It is the intention of the company to double the size of the plant next year, as already the demands made upon the station are very much more extensive than can be met with the present equipment. The company uses at the present time 24 miles of Edison underground tubes laid in the streets of Toronto, and these furnish a comprehensive system of distribution with mains and feeders of sufficiently large capacity.

Since the organization of the company the capital stock has been gradually increased until $500,000 is now invested in the plant and its equipment, and it is the intention to increase the capital of the company to $1,000,000. The president of the company is Mr. W. D. Matthews, a gentleman of great executive ability, who is also a director of the Canadian Pacific Railway, and generally interested in a number of financial institutions. Mr. W. R. Brock, the vice-president of the company, also occupies a high position in the commercial and financial affairs of Canada. The secretary and general manager, Mr. Frederic Nicholls, is well known to electrical people, both throughout Canada and the United States, and much of the rapid growth and solid financial condition of the company are due to his excellent management.

Electrical Progress in Vancouver, British Columbia.

The second station for incandescent lighting established in Canada was started in Vancouver, B. C., in September, 1887, by the Edison company. The machines installed at that time, consisting of a pair of Edison No. 10 dynamos together with an Edison municipal machine, became so overloaded by the excessive demands made for incandescent lights that a change in the plant was made necessary. The station was accordingly moved from its location on Hastings street to new quarters on Barnard street, where at the present time the splendid station of the Vancouver Electric Light and Railroad Company is situated. As is indicated by the name of the company it operates not only the lighting system for the city, but furnishes power for street railway purposes.

On the 26th of June, 1890, the first car operated by the company made its trial trip, and the service was then regularly commenced and has since been kept up in excellent shape. The main building of the power house is of brick on a solid stone foundation 80 × 65 feet. It is divided into two parts, one of which contains the boilers and pumps, the west side of this part opening on a wharf 100 × 65 feet where coal is unloaded from scows coming direct from the mines. A car house is placed on the southeast corner of the power house, and is 100 × 60 feet in size; in this are four tracks capable of holding 20 cars. In the boiler room two boilers are now in position, made by John Dotty & Sons, each of 150 h. p., and one of the same size made by J. McDougall & Son, of Montreal. These boilers are furnished with Jarvis patent settings. Water is supplied from the Vancouver water-works mains, but in case the pressure should not be sufficient a Buffalo duplex steam pump is ready for operation. The plant is also supplied with the Korting injector.

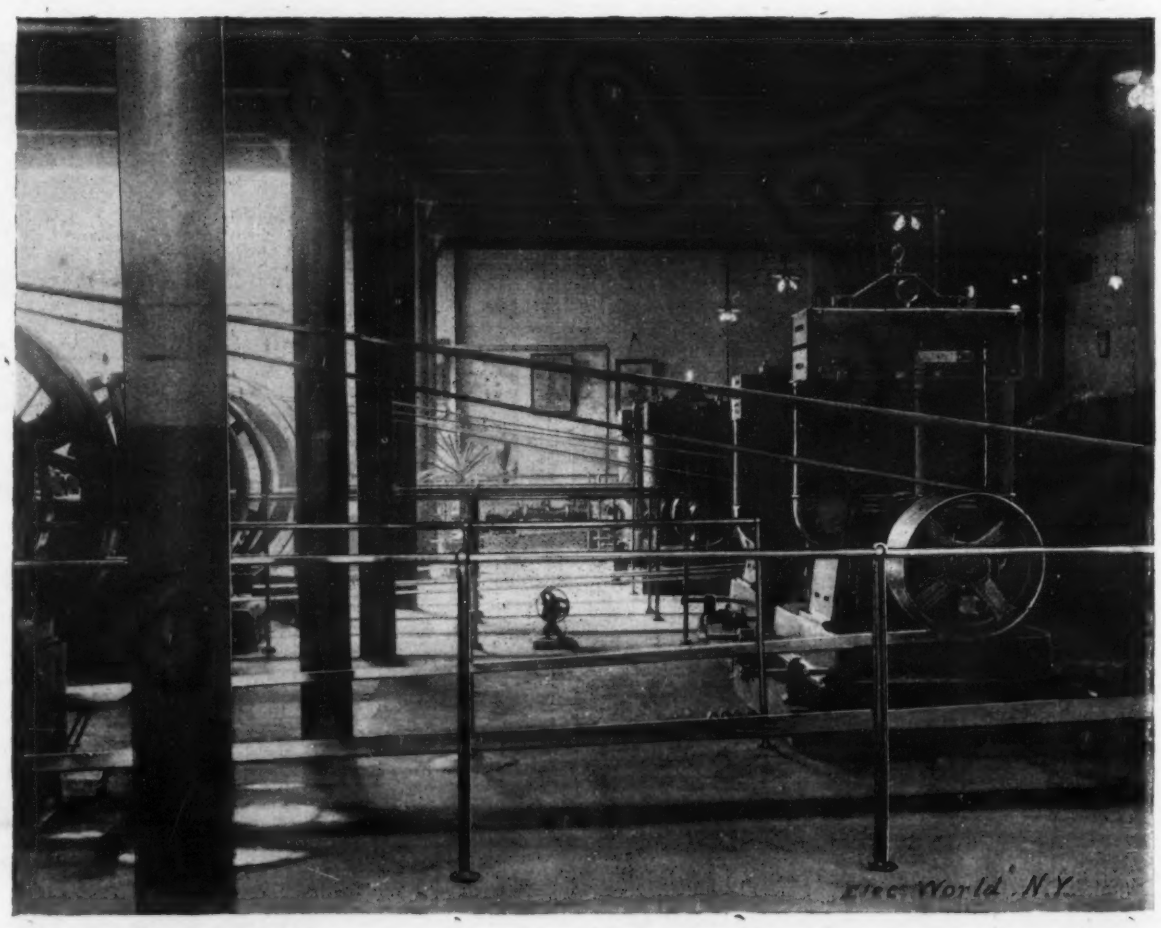
The engines are of the Armington & Sims manufacture of the high speed type. Two of them are of 125 h. p. each, and one of 75 h. p. The plant also contains a Westinghouse 150-h. p. engine. The exhaust steam from all the engines passes through a Lowe feed water heater. One of the Armington & Sims engines is belted direct to a 80-h. p. Thomson-Houston railroad generator, another one to the countershaft, to which two 50-light Thomson-Houston arc machines are connected. The second 80-h. p. railroad generator can also be belted to the countershaft in case of the breakdown of the second engine, but in fact the plant is so arranged that any machine can be belted from the countershaft or from itself on any engine so that a complete shutdown is almost impossible. The third 50-light Thomson-Houston arc light machine is run from the Westinghouse engine, as is also a 1,500-light Westinghouse alternating current dynamo. A second dynamo of this type will be run from the third Armington & Sims engine.

The beds for all the machinery are laid on cement foundations on the top of solid hard pan and are built up with brick and cement, giving a perfectly solid and at the same time durable base, as has been proved by the fact that the running of the engines is very steady, no vibration being noticeable whatever. The lighting dynamos and railroad generators are arranged across the power house, and above them is a traveling crane by which any machinery can be readily handled.

All wires from the dynamos are run under the floor to the switchboards, which are placed against the wall of the east end of the station. Of the three switchboards the one for the arc machines is placed against the centre of the wall and has connections for eight dynamos, so arranged that any combination of circuits and machines can be made. The switchboard for the railway dynamos and circuits is of polished Spanish cedar, and is placed on the right hand side of the arc switchboard and is similar to the incandescent board; these three boards present a very handsome appearance with their brass switches and highly polished woodwork.

The contract for lighting the city specifies that if a lamp is out for one hour it is "out for the night," and the company cannot collect for it from the city; this arrangement has given rise to a very efficient system of replacing damaged or injured lamps, by means of which it is possible to replace a lamp on any part of the circuits inside of the specified time limit of one hour. When the lamp gives out, a gong in the station sounds a signal for the benefit of the trimmers, which tells them that a lamp is out; one of the trimmers' wagons is always ready with two good lamps, and when the gong sounds "lamp out" the harness drops on the horse, the driver slides down his pole, hitches up, and off they go, the night lineman along with them, fire engine fashion. When the damaged lamp is reached it is lowered down, a good one put in its place, and the circuit turned on as quickly as possible, and in this way it almost always happens that no lamp is extinguished as much as a full hour.

The cars used on the railway lines are all built by the John Stephenson Company of New York, and have given entire satisfaction. They are fitted with motors of 15 h. p. each, two on each car, and these have done good service. The road bed is paved and laid with 25-pound T rails. The total length of the road is six miles and another nine miles of track has recently been put down and an order for six motor cars and trail cars has been placed. It has also been decided to install a 200-h. p. Corliss engine and three 80-h. p. railroad generators to be used for the new extension. The engine will be built by some one of the local engine works.

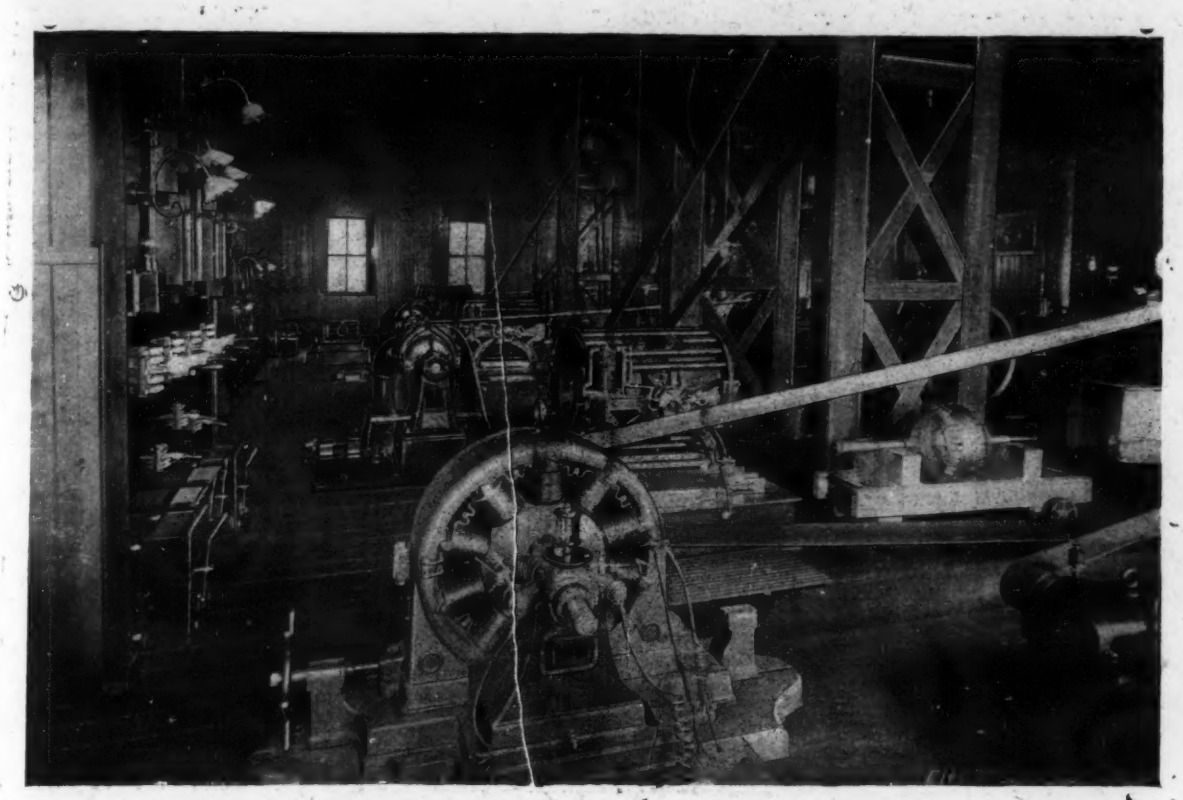


ENGINE AND DYNAMO ROOM OF TORONTO INCANDESCENT ELECTRIC LIGHT CO.'S STATION.

Some of the isolated lighting plants in Vancouver are as follows: Hotel Vancouver, 400 lights; Opera House, 500; Canadian Pacific Railroad service, 250; city market, 60; sugar refinery, 200; Gurney stables, 50. In the Vancouver

foundry there is a 100-light Thomson-Houston machine, in the Royal City mill a No. 6 Edison dynamo driven by an Armington & Sims engine, in the Hastings mill a 250-light Brush machine driven by a Ball engine, and a small plant in the Moodyville mill. The Sugar Refinery Company has also recently placed an order for a 300-light Crompton machine to be furnished by the Montreal agents, Messrs. Keegans & Milne.

The Edison General Electric Company has recently opened an office and warehouse in Vancouver where a full stock of all necessary supplies is kept on hand ready for prompt delivery. The Thomson-Houston Electric Company, of Boston, has also an agent in Vancouver.



THE VANCOUVER ELECTRIC RAILROAD AND LIGHTING COMPANY'S DYNAMO ROOM.

Mr. John Anderson, manager of the Vancouver branch of the Edison General Electric Company, has recently placed an order for a lighting plant, the installation of which will not be far from $100,000, and Mr. Samuel Robins, manager of the new Vancouver company, who has placed this order with Mr. Anderson, has studied the problem for some time, and has concluded that electricity is safer and cheaper than steam power. The plant includes an underground tramway, to be operated by two 30-h. p. electric mining locomotives, one 600-light dynamo and an 80-h. p. railroad generator, and a number of electric drills and coal cutters.

Some time ago the Vancouver Electrical Club was formed, and has now a membership of about 35. A suite of rooms has been engaged in Ferguson block, so arranged as to give accommodations for a reading-room, library, smoking-room and an additional room for experimental work. Both continuous current and alternating circuits are at hand, and with the aid of a number of instruments, transformers, batteries, motors and dynamos, the papers are discussed that appear in the electrical journals, which are regularly examined on each lecture night. All members, however, are allowed the free use of the various instruments and apparatus at all times. The management of the electric street railroad contributes liberally to the funds of the club. Mr. Dame, the superintendent of the railroad company, is the president of the society and is lecturer in chief.

The Edison company is carrying on building operations on its new block, which it is building in Vancouver. This building, when finished, will have cost $35,000, and it will be lighted by one of the Edison company's dynamos driven by water taken from the city service. The steamship Empress of India, trading between Vancouver and China, has a very complete electrical equipment. The installation includes four four pole dynamos coupled direct to Brown high speed engines, running at 350 revolutions per minute. The armatures of these machines are of the gramme ring type, and are 16 inches in diameter. The output is 150 ampères at 110 volts pressure, giving a total capacity of over 1,200 16 c. p. lamps. The mast and side lamps are also lighted by electricity, and the steamer is supplied with an electric search light of 20,000 c. p. Five motors, one for the barber, one for the printer, and three for driving the ventilating fans, complete the installation, which was made by Messrs. King, Brown & Co., of Edinburgh, Scotland.

Messrs. Keegans & Milne, of Montreal, have recently supplied a 300-light Crompton machine for a plant at Kamloops, a division station on the Canadian Pacific Railroad about 250 miles from Vancouver. Most of the 300 lights have been taken up by customers.

The Vancouver & New Westminster Electric Railroad Company and the New Westminster Street Railroad Company have consolidated and the plant will be operated under the management of one set of officials. The power house for the combined railroads will be half way between Vancouver and New Westminster and will consist of two boilers, 6 feet in diameter by 14 feet in length; three Ball engines of 125 h. p. each and three No. 22 Edison generators. The motors will be of 40 h. p. each of the single reduction type. Of the six railroads being built in Vancouver three are electric.

A Curious Case of Electric Shock.

BY DR. C. A. PERKINS.

It is well known that a severe shock of electricity may produce unconsciousness when the result is not fatal. Franklin describes an experiment in which he intentionally knocked down six men at once by an electric discharge of which they did not see, hear, or feel anything. The following experience, however, is different from anything that has ever come to my notice.

Mr. H. was working on a trolley car. He was wearing at his work an old pair of shoes with iron nails and no insoles. Standing with one foot on the rail of the dashboard he took hold of a wire that was accidentally connected with the trolley line, and at once received the whole force of 500 volts.

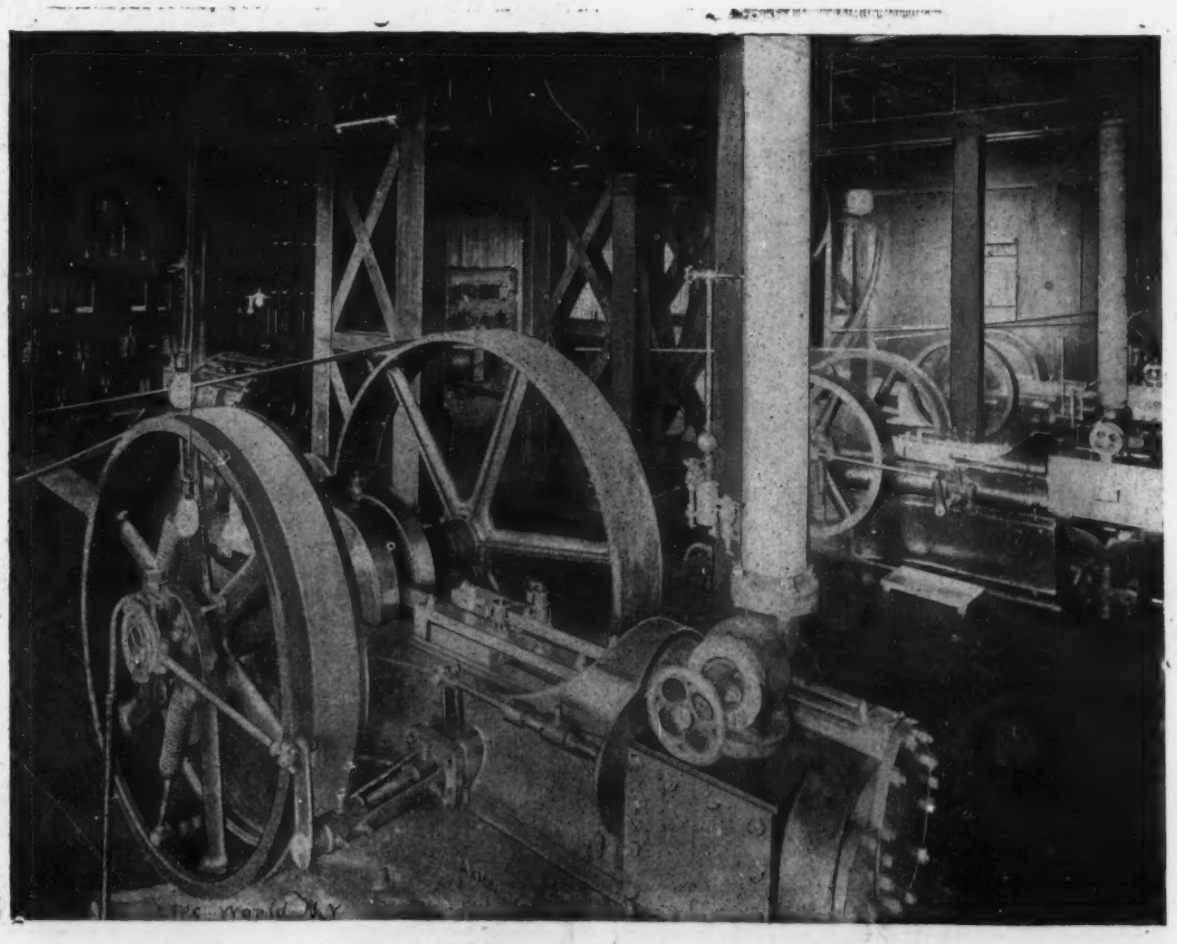
He was unable to call for assistance, but was sufficiently conscious to know that he must pull his hand off the wire and break the connection, and by a strong exertion he succeeded in doing this, wrenching his hand away and falling over.

By some chance he turned around as he fell, striking on his knees and shoulder, and so escaped any serious injury from the fall.

The curious thing about it was that he suffered no pain during this time and did not feel the blow of striking the ground, but imagined that he was a great bird, sailing slowly round and round, finally lighting on the ground.

He was able to get up immediately, and beyond feeling lame and stiff from the fall experienced no bad effects from the shock.

This condition of semi-consciousness seems to be about as far as one could go without fatal results if he were dependent upon his own exertions to extricate himself. It seems, however, that even conscious motion under such circumstances is not proof of suffering.



THE VANCOUVER ELECTRIC RAILROAD AND LIGHTING COMPANY'S ENGINE ROOM.

Can Galvanic Currents be Developed in Aqueous Solutions Without the Help of a Metal.*

The question is considered by Prof. W. Ostwald in a paper on chemical action at a distance recently published in the *Sitzungsberichte der kgl. Sächsischen Gesellschaft der Wissenschaften.* It may be differently stated thus: Is it possible to obtain currents of electricity in aqueous solutions by means of the building up and breaking down of ions?

Prof. Ostwald takes the case of two liquids (A and B) in contact with each other; A is able to develop positive ions, and B to break them down, or in other words, to develop negative ions. If the electricity is carefully conducted away these phenomena will readily occur. The following example must first be considered:

Take an aqueous solution of ferrous chloride and another of sodium chloride, saturated with chlorine, and place each in a small glass vessel, *e. g.*, a beaker. Next immerse in each solution a platinum electrode, and join them by means of a wire, which takes on its way a galvanometer.

The circuit is now closed by means of a siphon tube filled with sodium chloride solution, and having its ends covered with parchment paper.

Under these conditions, the galvanometer will show a current passing to the chlorine from the ferrous chloride, with the result that ferric chloride is formed in the neighborhood of the electrode, to the surface of which its formation is limited when the ferrous ions are transformed into ferric ions by the transfer of positive electricity.

Any other reducing solution may be employed in place of the ferrous chloride, and as a substitute for the sodium chloride saturated with chlorine, either a solution of bromine in sodium chloride, or one of potassium bichromate in hydrochloric acid may be used.

The case when the electricity is transferred through the solution without the intervention of metallic ions is a particular case of the foregoing.

Bi-sulphite of sodium and a solution of sodium chloride containing bromine may be employed and precisely comparable phenomena are observed.

In the first case the phenomenon of ferric chloride formation may be demonstrated by adding a little potassium sulpho-cyanate to ferrous chloride, and then the formation of ferric ions will be shown by the development of a reddish brown coloration at the proper electrode.

In the second case the presence of sulphuric acid may be proved by means of an acid solution of barium chloride, which gives a heavy white precipitate of barium sulphate.

Prof. Ostwald states that the change in the ions of the

*From the *Electrical Review* (London).

sodium bi-sulphate solution in this last case may be variously accounted for. The solution contains negative ions of the form $H SO_3$; these are changed into negative ions according to the equation:

$$2 H SO_3 + H_2 O = H_2 SO_3 + H_2 SO_4,$$

and the acids which result, namely, sulphurous and sulphuric acids, are either wholly or partially dissociated. In bringing this about the two negative units of the $H SO_3$ ions are necessarily removed, and they pass away to the other solution through the wire, where they act upon molecules of bromine (Br_2), changing it into bromine ions.

The same reasoning holds if the reaction

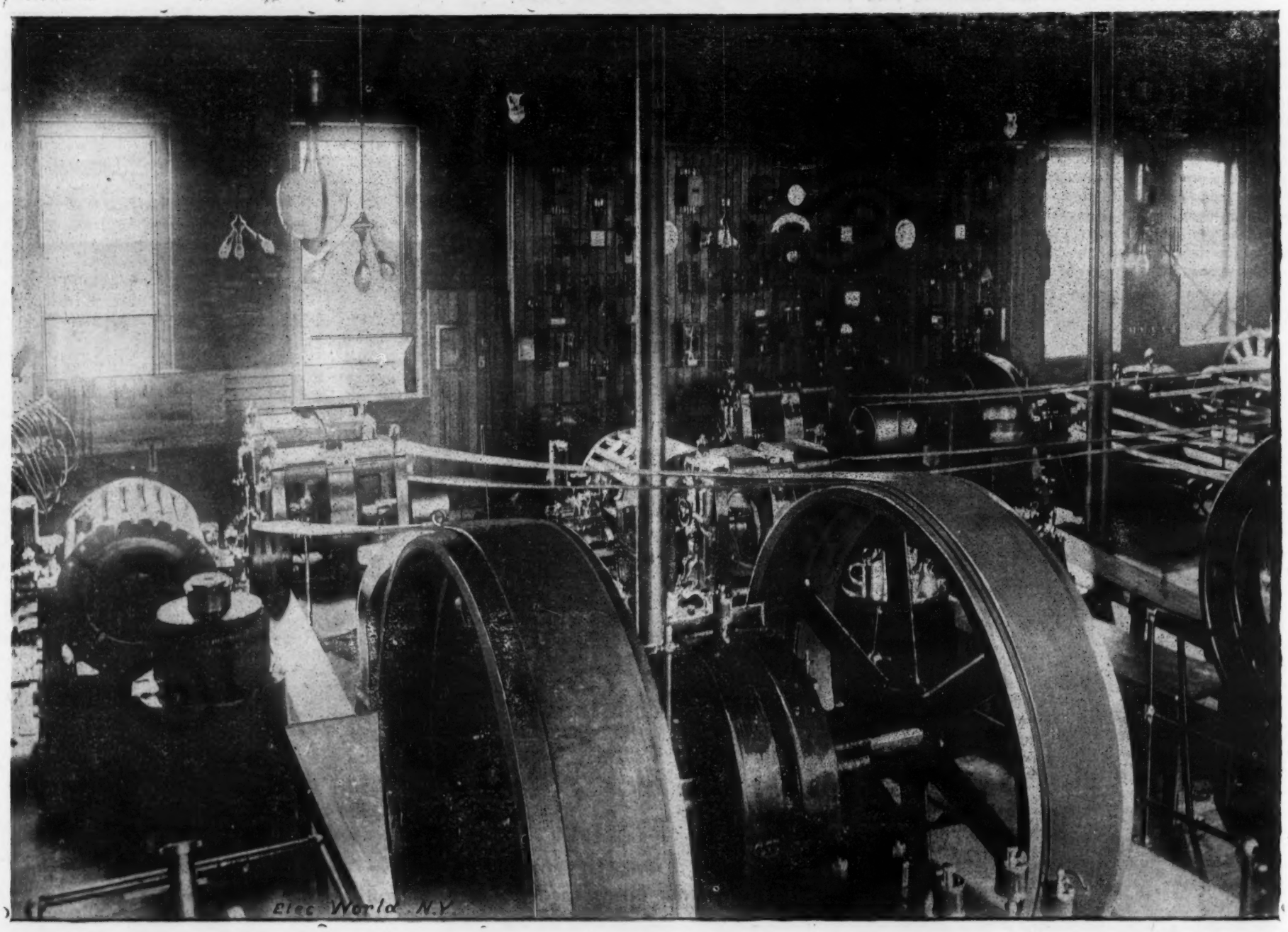
$$SO_3 + H_2 O = H_2 SO_4$$

be assumed for two units of negative electricity, each equal to 96,540 coulombs, pass through the wires for every molecule of sulphuric acid formed.

Prof. Ostwald's paper is well worthy of a careful perusal; in it he pays a high tribute to what he calls Arrhenius' extremely fruitful theory of free ions.

Electric Lighting in Halifax, Nova Scotia.

The accompanying illustration shows an interior view of the plant of the Halifax Illuminating and Motor Company, Limited, of Halifax, N. S., of which Mr. G. R. Coggswell is superintendent. The illustration shows a general view of the station.



FIGS. 1 AND 2.—ELECTRIC LIGHTING AT HALIFAX, N. S.

with the incandescent switchboard in the background, and the switchboard of the arc lighting system on the extreme left. The engine equipment consists of three McIntosh & Seymour 150-h. p. tandem compound engines, and one 150-h. p. Armington & Sims cross compound, all of which are belted direct to the dynamos. The electrical equipment includes two 750-light Westinghouse dynamos, one 600-light Thomson-Houston, and one 1,200-light, manufactured by the Royal Electric Company of Montreal, besides one 1,300-light Thomson-Houston alternator. All these incandescent machines are connected to and controlled from the incandescent switchboard, the switches of which are so arranged that all the circuits throughout the lighting district may be run from any one dynamo if it is desired. The arc switchboard is connected with five American 50-light 2,000-c. p. dynamos and two Thomson-Houston 50-light machines manufactured by the Royal Electric Company. Each lighting circuit has a Schuyler ammeter placed at a convenient point above the switchboard. The station is ventilated by a large exhaust fan placed in the centre of the ceiling and run by a 2-h. p. Excelsior constant current motor.

The boiler room contains five 120-h. p. tubular boilers and one 500-h. p. Babcock & Wilcox boiler, all fitted with Wickersham electric water level indicators. In the second story are located the superintendent's office, all the necessary storerooms, and a large workshop fitted with lathes, tools, etc., required in the repair of engines, lamps and dynamos. At the present time the station is fully loaded, and the demand for lights is constantly growing. It is the intention of the company to increase the capacity of its station so that it will be about double its present size. The working staff of the station is shown in Fig. 2. The officers of the company are: Charles Annand, president; George E. Forsyth, vice-president, and B. F. Pearson, secretary.

Queen's New Laboratory Photometer.

Messrs. Queen & Co. last spring took up the problem of producing an instrument for measuring the candle power of incandescent electric lights and have brought out the photometer here described. The instrument and accessories were designed by Mr. Elmer G. Willyoung, of Queen & Co., and the first one built was recently sold to the Standard Lamp Company, of Appleton, Wis.

The photometer is of the usual Bunsen type. Two tables, each 4 feet long by 20 inches wide, support the graduated bar and accessory pieces. These tables are of white wood with ebonized top and can be firmly screwed to the floor. The table legs unscrew, so that the whole apparatus can be packed in comparatively small compass for transportation or storage. The tables stand at such a height that observations may be taken by a man of medium height without bending. The bar is of metal supported by a larger bar of wood; the graduated bar is made in several different lengths and either graduated directly in candle power

or to half centimetres. The wooden bar is made with a cross rail along the bottom along which rides the carriage containing the Bunsen disc. This carriage is arranged so as to rotate through 180 degrees about a vertical axis, thus allowing measurements to be made with each eye alternately toward each light and hence taking the mean of observations, eliminating largely the errors due to differences of vision between the two eyes.

As a standard may be used a candle balance, a Methven screen, or an incandescent lamp as may be perferred. The left hand table is provided with cross rails parallel with the width of the table. The candle balance is mounted upon a base fitted to these rails and when drawn forward to the limit of the rails is in correct position for use as a standard. Pushing the back out of the way, brass bed plates are disclosed upon which the Methven screen or standard incandescent lamp (held by a special socket) may be placed and firmly fixed by means of two milled-head screws. The right hand table is also provided with bed plates in such a way that the universal socket, the Methven, or the standard incandescent lamp may be placed in position and their light measured by comparison with any of the other standards; hence the checking of the standards among themselves or the standardizing of the standard incandescent lamp can be very easily and quickly done.

The candle balance, shown in detail in Fig. 1, has been arranged for weighing candles while burning. The bar of

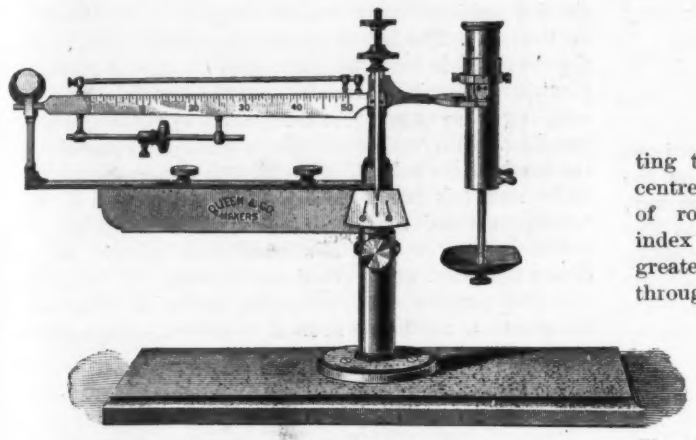


FIG. 1.—QUEEN'S NEW PHOTOMETER.

the balance is graduated in half grain divisions and differences of weight can be read off, by means of the rider, up to 50 grains. Equilibrium is secured by means of a counterpoise weight sliding along a rod beneath the balance beam. The rod itself is threaded at one end so as to be used as a micrometer adjustment when the counterpoise weight is fastened by means of the check screw. Either one or two candles may be used as desired. The balance also has an adjustment in its own length for bringing the line passing through the centres of the candle flames exactly at the zero of the scale.

For holding the incandescent lamp to be measured the universal socket, shown in Fig. 2, has been devised. By means of this socket any lamp of any make may be presented at any angle whatsoever to the sight box. This socket consists essentially of a lamp socket with its central axis perpendicular to a graduated circle. This socket can be rotated about this vertical axis and clamped in any position. The amount of rotation is measured by means of an index attached to the socket. A small set screw allows the index to be set at zero when the plane of the carbon filament is at right angles to the table length. The socket as a whole can also be rotated about a horizontal axis cut-

FIG. 2.—QUEEN'S NEW PHOTOMETER.

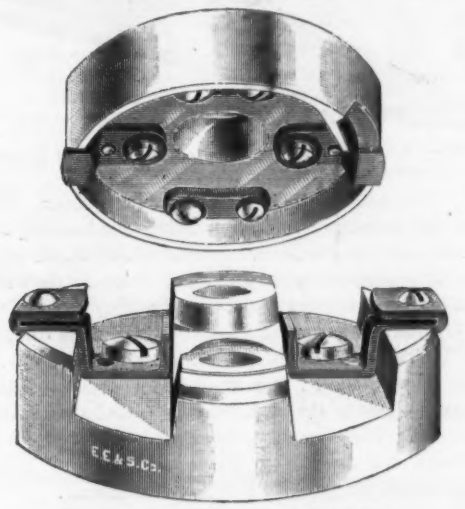
ting the line passing through centre of sight box and centre of illumination of the standard. The amount of rotation is read here also by means of an index and graduated circle. In order to bring the axis of greatest illumination of the lamp into the axis passing through the centre of sight box, the frame supporting the socket proper may be raised or lowered to whatever point desirable and there fastened. With the universal socket, as with the candle balance, there is a small adjustment in the length of the table, thus allowing the axis of greatest illumination to be placed exactly at the end of the scale.

A Combined Telephone and Switchboard.

In many factories and warehouses where different departments are located on different floors, or in different parts of the building, some means of communication between the heads of the various departments is necessary; a telephone system designed for this purpose is shown in the accompanying illustration. In the use of this system no exchange is required, each instrument being fitted with its own switchboard, so that any person wishing to communicate with any other telephone on the line has simply to place the switchboard at the proper point and ring his bell. At the left of the illustration is shown the ordinary type of telephone with the battery box, transmitter, bell and switchboard mounted upon a single base. The upper part of the illustration at the right shows the same construction, except that the outfit is not supplied with a battery, while the lower right-hand part of the illustration shows a portable telephone, consisting of a transmitter and receiver mounted upon a stand, on the base of which is placed the switchboard. The party using it has simply to turn the arm of the switch to the proper point upon it to place himself in communication with any desired phone in the building. These instruments are being used in many of the leading manufactories throughout Canada, and wherever used are said to give the greatest satisfaction. For the illustration we are indebted to Mr. T. W. Ness, a Canadian dealer in electrical supplies, located at 644 Craig street, Montreal, Canada.

Combination Ceiling Rosette.

The combination ceiling rosette, manufactured by the Electrical Engineering and Supply Company, of Syracuse, N. Y., as will be seen from the illustration, is very similar to the Standard "E. E. and S." rosette, with the exception of the base, which is so arranged that the branch wires to which it is connected can either pass directly through the slots shown in the base and make contact with the rosette through the screws and the brass parts as illustrated, when used with molding or cleat work, or the branch wires may come through the holes in the centre of the base of the



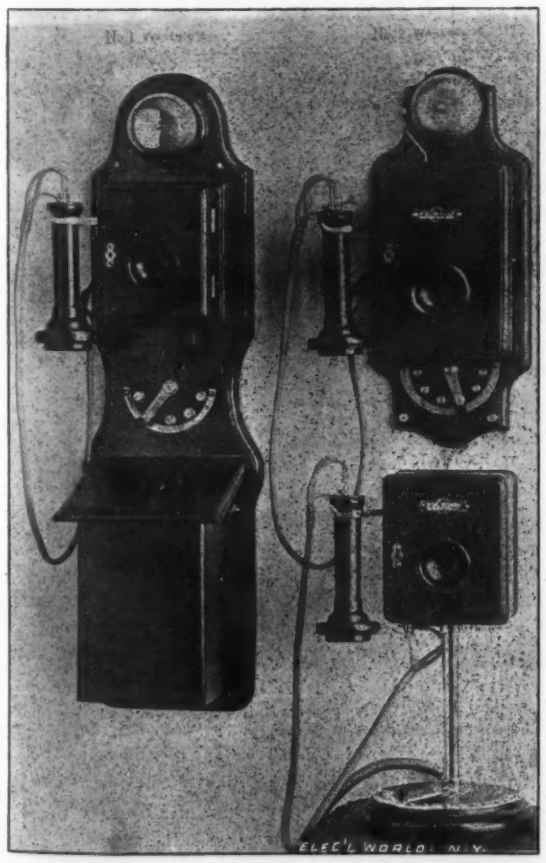
COMBINATION CEILING ROSETTE.

rosette and be attached to the screws in the contact pieces located in the slotted base.

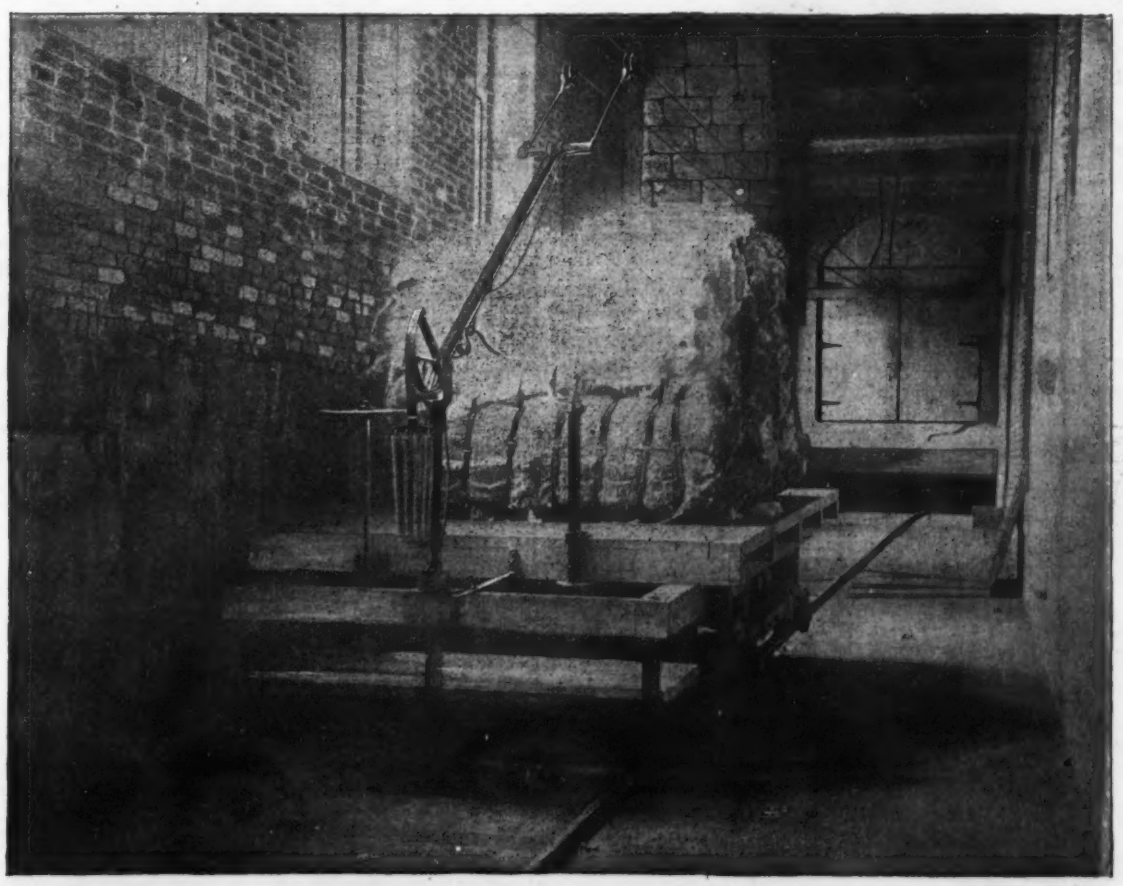
It will thus be seen that this rosette can be used under a variety of conditions, which makes it a very convenient design for supply companies to carry in stock.

Electric Tramways.

An interesting example of the saving in time and money made by the use of electricity as a motive power for the handling of heavy materials in manufactories is shown in the plant recently installed by the Thomson-Houston Motor Company, of Boston, Mass., at the mills of the Jackson Manufacturing Company, of Nashua, N. H. The Jackson company has for a number of years transported its cotton from the cotton house to the picker room by means of platform trucks running on rails, which were loaded with cotton and pushed along by men. When the motive power was changed to electricity the same rails were used, and the



COMBINED TELEPHONE AND SWITCHBOARD.



THOMSON-HOUSTON ELECTRIC TRAMWAY.

road was equipped with a three horse power motor car. Instead of the six men formerly employed, two men do the entire work, thus accomplishing a great saving both in time and money. A wooden tunnel, the full length of the cotton house (300 feet), about 8 feet wide by 10 feet high, contains the track. About every 50 feet openings are made in the tunnel from which the cotton is taken and loaded on the car.

The illustration shows the motor car with a load of cotton, near the end of the route. The iron doors seen at the

FIG. 1.—THE ANDERSON TROLLEY WIRE HANGER.

end of the tunnel open into the picker room. The motor car is also employed as a locomotive for hauling coal from the coal sheds to the boiler room, which is situated at the right of the tunnel next the picker house. As will be seen by reference to the cut, the double trolley system of wiring is used, thereby avoiding the use of the rails for the return circuit. The total length of the track is about 300 feet with a gauge of 4 feet. The road has a grade of three per cent., but loads of 4,000 pounds are easily handled by the motor car. The current is furnished by a 220 volt Thomson-Houston generator of the type known as D-7½, which also furnishes current for lighting the tunnel.

New Style of Anderson Trolley Wire Hanger.

The new forms of Anderson straight line trolley wire hangers, illustrated on this page through the courtesy of

FIG. 2.—THE ANDERSON TROLLEY WIRE HANGER.

the selling agents, the Engineering Equipment Company, of this city, possess several interesting features. Fig. 1 shows a specialty designed to bring the span and trolley wires as near together as possible. It is very easily placed n position by placing the span wire around the metal body or cap and slipping it under the lips of the projecting arm. Fig. 3 illustrates the ordinary hanger, which is easily applied to a tightly drawn span wire, but it possesses in common with that shown in Fig. 1 a feature peculiar to all of the trolley hangers and insulators that have been brought out by the Anderson Brothers. The upper part of the hanger

FIG. 3.—THE ANDERSON TROLLEY WIRE HANGER.

by which the attachment is made to the span wire is made of brass in the shape of a cap, with a slight projection on the inner side into which is forced, under great pressure, an insulating compound. The threaded brass thimble or stud embedded within the mass of insulating material enables any of the trolley wire clips now on the market to be readily attached. Although these new hangers have been but recently placed upon the market it is said that they have met with a ready sale, and may at present be found giving excellent satisfaction on the new electric railway lines in Paterson, N. J., and Johnson City, Tenn.

Fig. 2 shows a half sectional view of the Anderson railway bell insulator, made of solid insulating material. Besides possessing high insulating properties this material is very strong, tough and durable, and is said to be absolutely im-

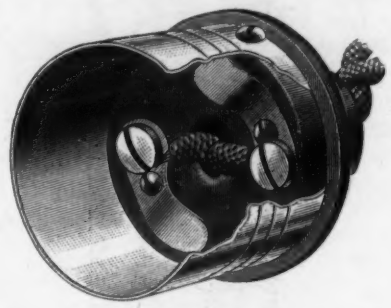


FIG. 1.—MCCREARY THERMAL CUT-OUT.

pervious to water and unaffected by atmospheric conditions. Fifteen hundred of these bells are now in use in Buffalo alone and wherever they have been tried have given perfect satisfaction.

The Messrs. Anderson, of Boston, who manufacture these materials, are represented in New York by their selling agent, the Engineering Equipment Company, at 143 Liberty street, and in Boston at 126 Pearl street.

McCreary's Pendant Thermal Cut-Out.

The accompanying illustrations show a new cut-out which has just been patented, and is now placed on the market by the McCreary Electrical Specialty Company, of this city. It can be attached to the flexible cord at any convenient distance from the lamp, thus bringing the safety

FIG. 2.—MCCREARY THERMAL CUT-OUT.

fuses where they can be renewed, if necessary, in a moment. This method avoids any trouble arising from the necessity of getting up to the ceiling and disconnecting the cut-out to renew a burned out fuse. The cut-out is designed for a connecting plug where a safe and convenient connector is needed, and it is also made with a wall base so that it can be used as a wall receptacle for any system. Fig. 2 shows the exterior of the finished cut-out, the interior arrangement of the parts and their connections being shown in Figs. 1 and 3. Fig. 1 shows the top view of the cut-out, while Fig. 3 shows the arrangement of the connections on the bottom of the cut-out, after it has been removed. The cut-out should always be suspended with the

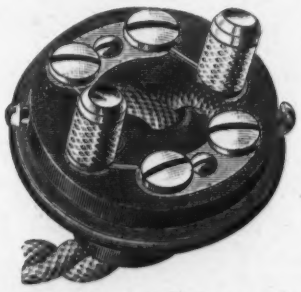


FIG. 3.—MCCREARY THERMAL CUT-OUT.

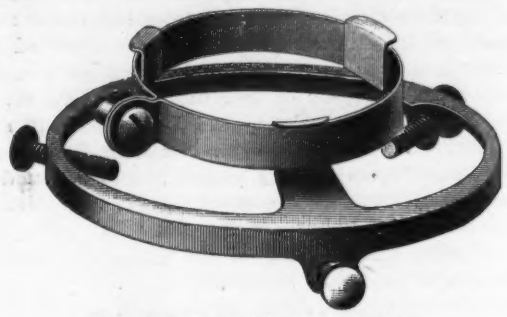
fuses next to the socket, and when used as a connecting plug or wall receptacle the part with the fuse should be attached to the flexible cord so as to avoid the trouble of putting in a new fuse near live terminals.

The Germania Shade Holder.

"Prove all things and hold fast to that which is good" is the motto of the Germania Electric Company, of Boston; and not until after two years' test by actual use of its shade-holder has it been decided to push it commercially. The accompanying illustration is a sufficient description of this simple device. It consists merely of two brass rings, one having inwardly projecting ears for holding the other. There are no joints to wear loose and no weak points to break. The shade or globe is held firmly. The metal used is a high grade of brass finely polished and the effect is very artistic.

New Pulley Clutch and Cut-Off Coupling.

The pulley clutch of which we give illustrations, showing it in whole and in detail, consists of a very few parts, simple in construction and compact in arrangement. Fig. 1 shows an end view and Fig. 2 a longitudinal section of the clutch. The long hub *I* cast to a brass pulley is bored out and lined with a brass bushing *J*. This pulley runs loosely on



THE GERMANIA SHADE HOLDER.

the shaft, and the long hub of the flanged coupling *H* is keyed on the shaft. The hub of this coupling is turned off to allow the sleeve *G* to move longitudinally on it. Each clamp is pivoted on a bolt *M*. These bolts are fitted into the flange of the coupling *H*, so as to cause the clamps to revolve with the coupling. For further security a plate *N* is placed under the heads of the bolts *M M* to tie the two together. The right and left handed screw *C C* works in brass nuts, which are fitted in the clamps *A A*, and by turning this screw in one or the other direction the clamps *A A* are either tightened or loosened on the hub *I* of the pulley. For the purpose of turning the screw *C C* in either direction a ratchet wheel is fastened to its centre,

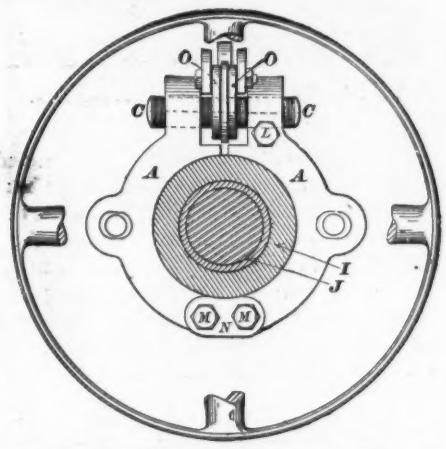


FIG. 1.—THE WOODCOCK CLUTCH PULLEY.

which engages with the pawl *D*. The pin on which this pawl works passes through two links *O O*, which are free to rotate on the screw *C C*. This pin also passes through the forked end of the lever *F*. The other end of this lever is attached to the sleeve *G* as shown. From the foregoing it will be seen that the links *O O* form a connection between the screw *C C*, the ratchet wheel, pawl, and the lever *F*. A finger *E* is fulcrumed on the back of the lever *F*, and a spring acting at one end causes the other end of the finger to press on the pawl *D*, keeping the latter engaged with the wheel. Now, by means of a suitable fork and collar in the groove of the sleeve *G*, a longitudinal movement can be given to the

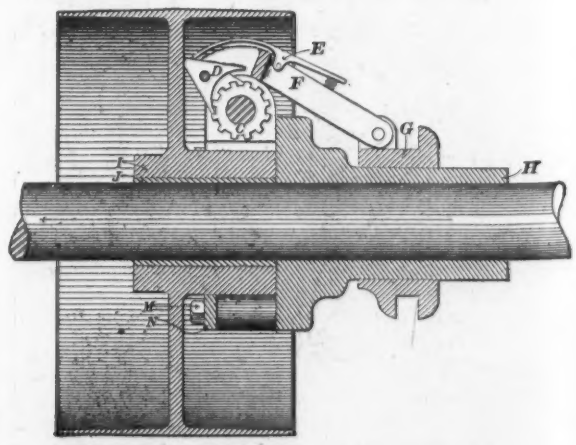


FIG. 2.—THE WOODCOCK CLUTCH PULLEY.

sleeve while the shaft is in motion. When the movement of *G* is toward the pulley, the lever *F* is carried forward, and the pawl and ratchet act to tighten the clamps *A A*, thereby transmitting motion to the pulley. When a loosening of the clamps is required the sleeve *G* is moved back sufficiently to reverse the pawl *D*. The finger *E* in this case will bear on the other side of the pawl, causing the ratchet wheel to loosen the screws. This at first sight may seem to be improbable, but it will be found on investigation that, as the lever *F* recedes the position of the pawl *D* relatively to the lever *F* changes, and when a certain distance has been passed

over, the finger *E* has ridden over the outer edge of the pawl *D* and the pressure is applied to the side of the pawl opposite that shown in the illustration.

This pulley and cut-off coupling is manufactured by the Allentown Foundry and Machine Company, of Allentown, Pa., under the patent of W. J. Woodcock, Auburn, N. Y.

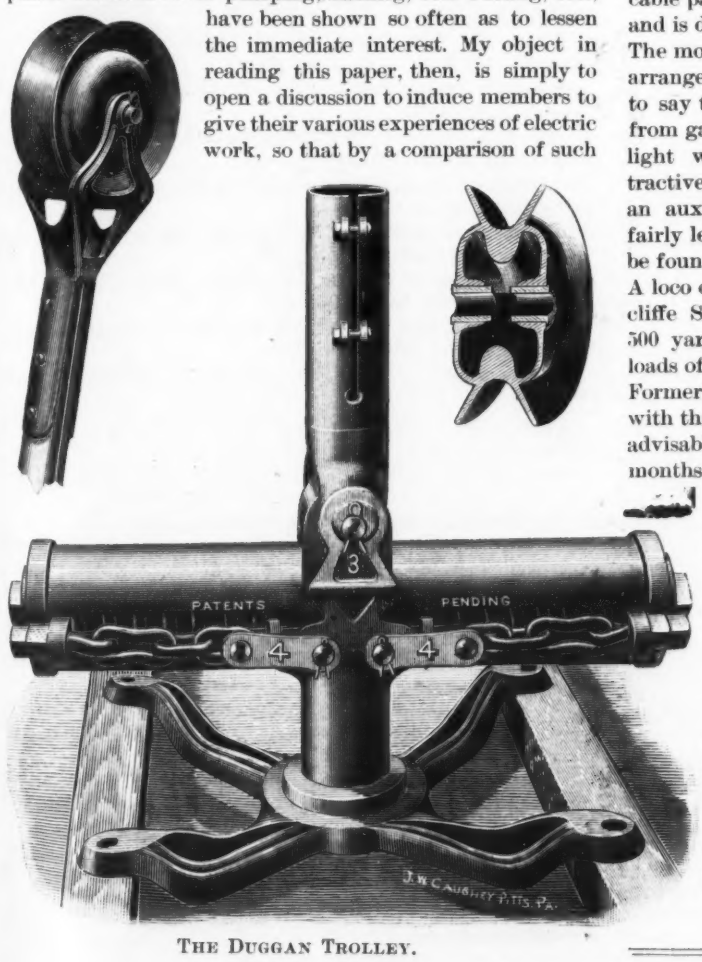
The Duggan Trolley.

The accompanying illustrations show the construction of a trolley recently patented and placed upon the market by the Pittsburgh Trolley Company, of Pittsburgh, Pa. As is shown in Fig. 1, it is a one spring compression trolley, and it will be seen that by a proper adjustment of the set screws in the links any tension that may be desired can be obtained, from 1 to 20 pounds. The spring is inserted in a cylinder or casing so that it cannot get out of place or out of working order. It is light and is easy and convenient to handle. The top of the base stands only seven inches above the top of the car roof and the pole may be drawn down at either end of the car. The wheel is made from the best bronze, provided with hardened bearings and will run from one to two weeks with only one oiling.

Notes on Electrical Work in Mines.*

BY ALBION T. SNELL.

Perhaps no branch of engineering has received more attention of late than the application of electricity to the ordinary purposes of mining. At home, on the continent, and in America, electrical energy has been applied to this work, and in the majority of instances with success. The general theory underlying the application of this power has been discussed again and again, and numerous illustrations have from time to time been given, so that in reopening the matter before the South Wales Institute of Engineers I feel some difficulty in selecting the precise lines for my paper. The theoretical side of the question is not a suitable subject for discussion here, and from the practical point of view, plants illustrative of pumping, hauling, coal cutting, etc., have been shown so often as to lessen the immediate interest. My object in reading this paper, then, is simply to open a discussion to induce members to give their various experiences of electric work, so that by a comparison of such



THE DUGGAN TROLLEY.

data we may be enabled to form an adequate idea of the work now being performed in collieries by this agency, and I hope that there will ensue a lengthy discussion which will materially add to the practical knowledge now extant on this important department of engineering.

With this view I purpose, even at the risk of describing what has already been published elsewhere, to briefly refer to one or two of the more important plants now running in Great Britain, and especially a pumping plant at Messrs. Crawshay Brothers' Newbridge Rhondda colliery. These plants have been erected under my own superintendence, and I have selected them because they are applicable for lighting as well as for power, and are so installed that the energy may be divided into separate units at different parts of the circuit, just as several engines can be driven off a compressed air system.

In February, 1890, the question of "The Electrical Distribution of Energy over Extended Areas in Mines" was discussed before the Federated Institute of Mining Engineers, and I then proposed the use of over-compounded dynamos for this purpose. When the matter was also discussed at the Newcastle meeting in 1891, I was able to state that several installations designed on these lines had been working successfully for some time. One of these was the Newbridge Rhondda colliery pumping plant, and by the courtesy of Mr. Abraham, the manager, I am able to bring the following details before you. This plant is typical of the system. It is successful here, and there is no reason to prevent it being equally successful under similar conditions in other pits. The problem was to drive two pumps off the same set of mains. The pumps were 700 yards apart, and it was required to make each independent, so as to be stopped or started without affecting the speed of the other. It was also imperative that the electric light should be used at the pumping stations, at the pit bank and pit bottom; and, further, there was to be only one dynamo. These conditions assumed that the pressure would be practically constant throughout the circuit. In practice it is impossible to secure an absolutely constant pressure all over the system, owing to the resistance of the mains themselves; but by over-compounding the dynamo, so as to give a constant pressure at a point near the centre of the system, it is possible to approximate very closely to the required conditions. How well the case has been met is apparent when I mention that both the pumps can be switched off without appreciably raising the voltage of the lamps. The dynamo is one of our Sh. D. C. 12-16 type, and running at 800 revolutions per minute gives a pressure of 300 volts and 60 ampères. Each of the motors gives 7 b. h. p., and runs at 800 revolutions per minute. The lamps are coupled in series of three. The pumps are three-throw rams, 4 inches in diameter by 9-inch stroke. Mr. Abraham tells me the plant has been perfectly successful from the first, and he hopes to extend the use of electricity at an early date.

Another interesting application of electricity which is likely to be of use in certain cases is a new system of haulage patented by Messrs. G. B. Walker, of Wharncliffe Silkstone, and Immisch, of the G. E. P. and T. Company. In this system the loco does not depend for grip on its own weight, but gets a direct pull on a cable lying between the rails, parallel to the road, and fixed at either end. This cable passes over a sprocket wheel on the loco or trolley, and is driven through suitable gearing by an electric motor. The motor is supplied with energy from a bare copper wire arranged on the roof or the side of the road. It is needless to say that such a trolley is only applicable to roads free from gas. The chief advantage of the system lies in the light weight of the trolley in proportion to the heavy tractive effort it can exert. It will be principally used as an auxiliary power on short steep lengths of otherwise fairly level roads, where horses are generally used, and will be found in many cases to be a great saving in horseflesh. A loco or trolley of this type has been running at Wharncliffe Silkstone collieries for nearly 12 months on a brow 500 yards long, with a grade averaging 1 in 9. It raises loads of about five tons at a speed of three miles per hour. Formerly, 12 horses were required for the work, and even with this number it was so severe that it was not deemed advisable to keep the same animals at it for more than six months at a time. Mr. Allison, my assistant, who erected the line, gives me the following figures, roughly measured, which will be interesting from an electrical point of view:

Rolling load	5 corves	4 tons.
Average speed	2.65 miles per hour.	
Average grade	1 in 9½	
Grade 1 in 12	Ampères, 45	Volts, 180.
Grade 1 in 11	Ampères, 50	Volts, 190.
Grade 1 in 10	Ampères, 55	Volts, 195.
Grade 1 in 9	Ampères, 65	Volts, 200.
Grade 1 in 8	Ampères, 70	Volts, 205.

Since the above figures were taken a larger dynamo has been installed, and the loco will now do more work.

The loco trolley is unnecessarily heavy for the particular work, and was adapted for existing material; considerable improvements can be made in the design in future. The motor is rated at 10 brake h. p.

(To be continued.)

* Paper read at the annual meeting of the South Wales Institute of Engineers, July 27, 1891.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

The Closing Quotations of electric stocks on Friday, Sept. 4, 1891, in New York and Boston were:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
NEW YORK.				
Western Union Telegraph Co	100	86,200,000	83¼	83½
American Telegraph & Cable	100	14,000,000	....	80
Central and South American	100	5,000,000	....	135
Mexican	100	2,000,000	200	215
Commercial Cable Co	100	7,716,000	107	....
Postal Telegraph Cable	100	5,000,000	....	....
Edison General Electric	100	9,503,500	98	98½
" " " Deferred	100	2,496,500	....	....
Consolidated Electric Light	100	1,929,400	....	30
Edison Electric Illuminating Co	100	2,567,800	79	80
United States Electric Light	100	1,500,000	15	25
North American Phonograph	100	6,200,000	....	....
BOSTON.				
Thomson-Houston Electric Co	25	6,000,000	46⅛	47
" " preferred	25	4,000,000	25	26
" " Series C	10	400,000	....	....
" " Series D	10	120,000	....	....
" International Co	100	1,000,000	....	....
Thomson Welding Co	100	1,000,000	44	44½
" European Welding Co	100	1,000,000	55	60
Ft. Wayne Electric Co	25	4,000,000	13	13⅛
Westinghouse Electric Mfg. Co	50	5,000,000	14	14¼
Telephone:				
American Bell	100	12,500,000	177	179
Erie	100	4,800,000	44½	45⅛
New England	100	10,304,600	49	....
Mexican	10	1,280,000	....	....
Tropical American	10	400,000	....	....
Edison Phonograph Doll	10	1,000,000	....	.50

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone and electric light stocks as follows:

TELEPHONE STOCKS.

Chicago	$230	@ $238	Cumberland	$60	@ $62
Central Union	52	@ 53	Wisconsin	118	@ 120
Michigan	83	@ 84	Bell of Missouri	160	@ 165
Great Southern	30	@ 32	Iowa Union	20	@ 22
Colorado	34	@ 36	Missouri and Kansas	54	@ 56
Rocky Mountain Bell	40	@ 43			

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$95	@ $100	Chicago Edison Co $145 @ $150

NEW INCORPORATIONS.

The Waterloo Electric Light and Power Company, of East St. Louis, has been formed with a capital stock of $10,000. Its incorporators are William Murdock, R. M. Hammon and M. A. Waters.

The Paxton Electric Company, of Paxton, Ill., has been incorporated with a capital stock of $24,000 to furnish electric light and power. Its promoters are C. H. Langford, H. B. Henderson and J. L. Larkin.

The Mascoutah Electric Light Company, of Mascoutah, Ill., with a capital stock of $5,000, has been formed to furnish electric light and power. George Postel, Fred. Dilg and E. P. Hagist are the incorporators.

The Kensington (Pa.) Electric Street Railway Company has been organized with a capital stock of $12,000. The directors are John S. Alles, S. Stafford, A. E. Alles, Henry Alles, Sr., and Jacob C. Alles, of Pittsburgh.

The Ironton (Colo.) Water, Light and Power Company has been organized with a capital stock of $50,000. The principal place of business will be at Ironton. J. N. Casanova, a Pennsylvania capitalist, and others are interested in the new company.

The Enterprise Electric Light and Railway Company, of Kankakee, Ill., has been incorporated with a capital stock of $100,000, to construct and operate a street railway, and furnish electric light and power. The promoters are August D. Ehrich, Thos. H. Magruder and Wm. A. McGillis.

The McCook Electric Light Company, of McCook, Neb., with a capital stock of $30,000, has been organized to prosecute the business of arc and incandescent lighting, and furnishing steam and electric power. Frank Ganuth, S. W. Huddleston, Geo. Hukhell and A. Campbell, all of McCook, are the promoters.

The Manchester Sanitarium Company, of Manchester, Ga., has been organized with a capital stock of $30,000, to establish and maintain a sanitarium with all proper appliances, electric, etc. Its organizers are J. J. Knott, J. A. Scott, E. M. Blalock, W. A. Russell, J. W. English and H. H. Cabiniss, all of Atlanta, Ga.

AFFAIRS OF THE COMPANIES.

St. Paul, Minn.—The Rapidan Water and Electric Power Company has filed with the Secretary of State an amendment to its articles of incorporation changing the title to the Duluth Linseed Oil Company.

The Edison Electric Light Company, of Easton, Pa., has paid its fourth semi-annual dividend of three per cent. from the net earnings of the company. A substantial surplus still remains in the company's treasury. This concern began business in January, 1886, and has paid at the rate of six per cent. per annum on its capital stock ever since.

The Natick (Mass.) Electric Railroad Company at a meeting of its stockholders last week elected the following directors: Albert W. Pond, of Boston; T. T. Robinson, of Dedham; W. B. Furguson, of Malden; Francis Bigelow, H. H. Whitney, W. D. Parlin and H. W. True, of Natick. It is expected that the work of construction will be begun early this month.

Duluth, Minn.—The Hartman Electric Company at its annua meeting chose the following directors: A. W. Hartman, O. C. Hartman, M. O. Hall, R. A. Costello, Paul Sharvy, C. E. Van Bergen and W. C. Roberts. At a directors' meeting the following officers were elected: A. W. Hartman, president; W. B. Roberts, vice-president, Paul Sharvy, secretary; M. O. Hall, treasurer; C. E. Van Bergen; assistant secretary and treasurer.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Sept. 5, 1891.

The National Conduit Company has secured a further order of 40,000 feet of conduit from the Detroit Telephone Company.

Mr. H. S. Winston, President of the Illinois Electric Material Company, Chicago, is visiting Captain Henry Erben, U. S. N., Commandant of the Brooklyn Navy Yard.

Ball Engines in New York City.—The Hebrew Institute, New York City, is installing an 80-h. p. engine, furnished by the Ball Engine Company through its representative, E. T. Copeland, 106 Liberty street, New York City.

The New York Insulated Wire Company will exhibit at Montreal an elaborate display of new "Vulca" tubing, showing different processes which the tubes will stand. The company will also have a full line of Grimshaw wires, tapes, etc. J. W. Godfrey, the general manager, will be in attendance.

Messrs. Pass & Seymour, of Syracuse, N. Y., manufacturers of the celebrated electrical china, are steadily increasing their business. They are now manufacturing over 450,000 pieces per month, and are having a great demand for fixture cut-outs. Mr. A. B. Seymour will be at the Montreal Convention with a full line of samples.

To Meet the Special Train.—For the benefit of those of our readers who do not attend the Montreal Convention it may be stated that the special train leaving New York on Sunday morning will be met at St. John's, that evening, by a large delegation from the convention city, under the auspices of the executive committee of the association.

The Aluminium Carbon Company, of Buffalo, N. Y., is making a great success of its carbons and is now turning out 40,000 per day. In recent tests these carbons have shown the best results for long life and low resistance. Mr. F. V. Doty, the general manager, will be at the Montreal Convention, where he will have a full line of sample carbons.

The Onondaga Dynamo Company, 225-229 Water street, Syracuse, N. Y., is going into the manufacture of dynamos and motors, and some electrical specialties, and will also do repairing,

etc. Mr. F. E. Averill, who has made a number of inventions and improvements in electrical apparatus, will be electrician of the company. Mr. J. W. Eager, a well-known business man of Syracuse, will be the business manager of this new concern.

The E. P. Gleason Manufacturing Company has started up its glass business this season earlier than usual. Mr. M. W. Gleason, manager, reports enough orders on hand to require continuous running until Jan. 1, without another order coming in; this, too, in the face of extensive additions to the factory that the company has been making this summer, increasing its capacity some 1,000 dozen globes a week. Wm. F. Cullin will represent the company at the Montreal Convention.

Johnson's Vise Lock Switch has just been placed upon the market by the Interior Conduit and Insulation Company, of New York City, and a description of it is given in Circular Letter No. 20, just sent out by that company. The switch does not depend upon springs for the maintenance of contact and the movement is independent of the contact pressure. It is said that the rapidity of its motion is so great as to render it practically independent of the electromotive force of the circuit. Its principles and details will be explained at the Montreal Convention to any who care to examine those on exhibition.

The Ries Electric Specialty Company, of Baltimore, Md., will be represented at the Montreal Electric Light Convention by its vice-president, Mr. Lewis S. Greensfelder, who promises to have a genuine surprise in store for the central station men and their electrical friends, in the shape of the new regulating socket for alternating current incandescent lamps, now about to be placed upon the market by this company. This socket permits the lamp to be burned at any desired degree of brilliancy, from a barely perceptible glow, up to the full c. p. of the lamp. The company, without having sent out a single announcement, has already a large number of orders on its books.

The Interior Conduit and Insulation Company, of New York, will be ably represented at the Montreal Convention by its President, Mr. Edw. H. Johnson; General Manager E. W. Little and E. T. Greenfield, Electrician. As usual the company will present a complete exhibit of its admirable and now generally adopted system of electric wiring. This being the first opportunity presented since the company has embarked in the general electrical manufacturing business to make an exhibit of its new appliances and apparatus, it is expected that many new devices will be shown. The Johnson ampère meter, an absolutely dead beat instrument, and the Johnson vise lock switch will be found to be worthy of attention. The switch, the last invention of Mr. Johnson, will be found of especial interest. The recent tests upon the first models have excited the admiration of many prominent electricians. A neat circular upon this switch will be distributed at the convention. The company also promises to show the new California arc lamp which it is about to place upon the market. This lamp is only fifteen inches in length, has no obstruction underneath, consequently casting no shadows, and will burn over 90 hours without trimming or change of carbons. For economical and other recognized advantages this new departure in arc lamps will be worthy of special attention from those visiting the exhibition. The Garland carbon protector is another device that is promised to be shown. This will be found specially useful in enabling the users of the single carbon type of lamp to enjoy all the advantages of long life of carbons, hitherto only accomplished by the use of double carbon lamps. It is claimed for the Garland carbon protector that it is effective in decreasing the consumption of the carbons from one inch and a half to one-half inch per hour. Other useful and novel appliances especially applicable to the conduit system will also be shown. L. H. H

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 28, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Sept. 4. 1891.

I. S. Spencer & Sons, Guilford, Conn., have added to their list of manufacturers' bronze and brass name plates for dynamos, motors, etc., and are turning out some very artistic work in this line.

H. N. Bates & Co. are moving into their new store, 242 to 246 Congress street, where they will have ample facilities to handle their business, which has outgrown their present quarters on Pearl street.

The Pettingell-Andrews Company has just placed upon the market a new brand of line wire called "P. A." triple braid, which, it is claimed, is far superior to anything of the kind used heretofore.

The Jarvis Engineering Company is constantly receiving orders for the popular "Jarvis" boiler settings, which seem to be very popular among the central station people. Their new shaking grates are especially in demand.

Gloucester, Mass.—The new electric plant of the Gloucester Street Railway Company was given a trial on Sunday of last week for the first time; the test was satisfactory in every way, and the Gloucester line was opened for public traffic on Thursday.

The Electric Gas Lighting Company is manfacturing a very neat and substantial needle annunciator called the "Hub," which, judging from the sales, seems to meet the requirements of a first class article at medium cost, and one which may be depended on at all times.

A special train will leave Boston on Sunday the 6th at 10 A. M. for the convention at Montreal via the Central Vermont and Grand Trunk routes. This train will meet one leaving New York at 8 A. M. at Rutland, whence they will go into Montreal together, reaching that point about 10 A. M.

Mr. Joseph E. Lockwood, of the Detroit Electrical Works, is superintending the installation of the Rae system on the Merrimac Valley Street Railroad at Lawrence, Mass., where 15 cars with 40-h. p. Rae motors will soon be carrying passengers, the trial trip having been made on Aug. 31.

A New Mining Plant.—The mining department of the Thomson-Houston Electric Company has received an order for the complete electrical equipment of the Queen of the Hills Mine in Montana. The contract is for about $40,000 worth of machinery, including hoists, large pumps, drills and lights.

The Consolidated Electric Manufacturing Company, of which Mr. Chas. E. Bibber is general manager, has moved its office from 196 Summer street to 154 Franklin, where Mr. Bibber has much more commodious quarters, including a large salesroom. This move was made imperative by the increasing business which Mr. Bibber says is the best in the history of the company.

Boston, Mass.—The West End Street Railway management expects to have electric cars running on the Jamaica Plain line by Oct. 1. The cars will not stop at the Tremont House as now, but will be run through to the railroad depots. By Jan. 1 it is believed that fully one-half of the company's lines will be equipped with electric power and that 425 long electric cars will be in service.

The Germania Electric Company is pushing out energetically, and its rapidly growing business is requiring constant additions to its office and factory force. One of its most recent appointments is Mr. B. B. Stoddard, who will represent the company in Philadelphia. Mr. Stoddard has been connected with the Woonsocket (R. I.) Electric Machine and Power Company for several years, and has had a wide experience with incandescent lamps and apparatus. Mr. Stoddard will go to Philadelphia about Sept. 15 to open an office.

The Bryant Electric Company has been bringing out a full line of new specialties and will have a nicely arranged sample board of these at the convention. The company will also have its well known sockets on exhibition. A full line of branch cut-outs and main line cut-outs has been brought out and also a new single pole, five and ten ampère switch that is expected to eclipse all other switches in price and quality. The Bryant company's well known double pole switch has a steady sale and is growing in popularity. The company will be represented at Montreal by L. W. Eaton and W. C. Bryant. C. A. B.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, Sept, 4, 1891.

The Electrical Supply Company, Chicago, will be represented at Montreal by Mr. Wm. Taylor, the assistant manager.

The Falls Rivet and Machine Company, Cuyahoga Falls, O., will have their interests looked after at Montreal by Mr. F. W. Weir, manager of the Chicago office.

Mr. J. M. Thomas, secretary of the Chicago Belting Company, 26 West Randolph street, Chicago, Ill., is in receipt of some handsome orders for leather belting from central station plants.

Denver, Colo.—A movement is on foot for the establishment of a plant for the manufacture of electric generators and motors. Mr. A. D. Adams is interested, and he is making an effort to interest Denver capitalists in the enterprise. F. de L.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Design of Electromagnets.—(J. L. C.)—With reference to your question about designing electromagnets for raising a given weight a given distance, would refer you to Thomson's "Electromagnet," which is a very practical book for working out such problems, and which will help you more than we can in the space at our disposal.

Electric Railway Working.—(1) What rules or regulations are published in America for electric central stations and railway tations, with reference to preventing accidents? (2) Are there any electric railways working on the underground system, and are those practical? (3) Do you have central stations which give power for electric lighting and electric railway at the same time, and are they practical? N. E. M.

(1) Write to the National Board of Fire Underwriters, Mutual Life Building, Nassau street, New York City, for fire rules. Municipal regulations vary widely in various parts of the country. (2) We have in this country nothing more than experimental electric conduit lines, and these are few in number, and they are very short. There is no conduit system in successful operation. (3) Yes; many central stations furnish both power for railways and lights, though of course not from the same dynamos.

Electric Brake.—I shall be very glad to hear whether anywhere in the United States an electric brake for street railways is in use; or if anything reliable has ever been designed. We have built an electric road in Switzerland, used both for passenger and freight traffic, a 50-h. p. locomotive on which is hauling two or three cars. Now the authorities ask for a continuous automatic brake, acting like the Westinghouse vacuum brake, and to be used by the motor man for all cars. T. H. D.

A considerable number of electric brakes have been proposed and patented, but none of them have come into anything but the merest experimental use. Good results have been obtained by using vacuum brakes, the working parts of which are operated by a sprocket chain from the car axle or by independent motor. On very heavy grades the best results have been obtained from powerful track brakes. These are in use on some of the San Francisco cable roads, where some of the grades are exceedingly severe. Aside from regular vacuum brakes, true electric braking by working motors as dynamo on down grades has been tried a few times with a fair degree of success.

Dynamo Winding.—I have a Manchester type of dynamo, with a ring armature seven inches in diameter and seven inches long, wound with one layer of No. 14 wire. I run it 2,800 revolutions per minute, supplying 100 volt 16 c. p. lamps. I understand that it takes .6 of an ampère for each 100 volt 16 c. p. lamp, and one authority gives 16.2 ampères as the maximum safe current for a No. 14 copper wire. As the circuit is divided through the armature 32.4 ampères would be the maximum safe current for my dynamo, in which case it would supply 54 lamps at .6 of an ampère per lamp; is this right? If not, state the maximum number of lamps I could run with safety. O. F. P.

Your calculation is about right; 16.2 ampères is a considerable load for a No. 14 wire, but as you have only one layer and run at a high speed so that the wires gets a chance to cool from the circulation of the air, it will probably not be excessive, although the current density is rather greater than that generally allowed in dynamos. Fifty-four lamps would be a pretty heavy regular load, but you might try it temporarily; we should say that 40 lamps would be near the usual capacity for such a machine.

Electrical Measurement of Horse Power.—(1) How can I find the horse power required at the pulley of an arc dynamo, and what data are necessary? (2) Do the same rules apply to either arc or incandescent machines? (3) Please explain the so-called weighing method for getting the horse power of a machine.

Young Subscriber.

(1) The simplest way of finding the approximate horse power required at the pulley of a dynamo is to get the output in ampères and volts, reduce it to horse power, then from the resistance of the dynamo and the current get the electrical losses, and, if you like, from the speed and dimensions of the core, the hysteresis losses. Add these together, and add perhaps five per cent. for friction and incidental losses, and you will get a close approximation of the power required at the pulley. (2) In arc lighting the power required is very nearly one h. p. per lamp of ordinary size; in incandescent lamps about one h. p. for 10 lamps. (3) The weighing method, usually referred to as the Prony brake method, is in principle exceedingly simple. It simply measures the pull in pounds exerted at the periphery of the pulley, when, knowing the speed per minute, the foot pounds of work per minute and the horse power can be immediately determined. For formulæ and details would refer you to The Electrical World, vol. XV., pages 195 and 205, where the whole subject is discussed with great thoroughness.

News of the Week.

THE TELEGRAPH.

Madison, Wis.—The North American Telegraph Company announces the opening of an office at Madison.

Pine Bluff, Ark.—The Western Union Telegraph Company has placed a large number of clocks run by electricity in the hotels, restaurant and saloons of Pine Bluff.

THE TELEPHONE.

Portland, Ore.—There is talk of connecting Portland and Hillsboro by telephone.

Washington and Centerville, Ga.—A telephone line is being constructed between these two towns.

Pittsburgh, Pa.—The Central Telephone Company has begun active work in laying its wires underground in compliance with the recent ordinance of the Council compelling the telegraph, telephone and electric light companies to remove their overhead wires.

Willimantic, Conn.—The Willimantic Linen Company has erected a short distance telephone line connecting the office with the packing-room, winding-room, etc., thus saving time in carrying messages between rooms that do considerable business together but are distant from each other.

Reynoldsville to Du Bois, Pa.—Work on a telephone line from Renoldsville to Du Bois has been commenced, and it is expected it will be completed by Oct. 1. This line will connect at Reynoldsville with the one running from Clarion to Punxsutawney, and at Du Bois with the Eastern Pennsylvania system. Messrs. J. F. and G. E. Brown have the contract for this line, and will also build another telephone line this fall from Punxsutawney to Blairsville to connect at the latter point with the long distance telephone system between New York and Chicago.

THE ELECTRIC LIGHT.

Aledo, Ill., is to have electric lights.

Harlan, Tenn., is now lighted by electricity.

Ingram, Pa., will soon be lighted by electricity.

Ebensburg, Pa., will shortly have an electric light plant.

Madison, Wis.—The City Council has contracted for more electric lights.

Appleton, Wis.—The county jail at Appleton is to be lighted by electricity.

Weston, Ore., is agitating the subject of the purchase of an electric light plant.

Raleigh, N. C.—Electric lights are to be introduced into the Greensboro Female College.

Columbus, Ind.—It costs Columbus $2,300 a year to run her own plant of 68 electric lights.

Provo, Utah, will soon have an all-night system of electric light and a telephone service.

Oyster Bay, N. Y.—It is said that the electric light is to be introduced in Oyster Bay very soon.

Richmond, Ind.—A company has been organized to supply private consumers with electric light.

La Porte, Ind., is being supplied with 48 new electric lamps, which will cost about $3,000 a year to maintain.

Le Mars, Ia., is putting in a system of electric lights at a lower rate, it is claimed, than any other town in Iowa.

Grand Haven, Mich.—The new electric lighting system is expected to be in operation by Oct. 1, at the very latest.

Rockland, Mass.—The foundation of the electric light plant has been completed and work is now going forward on the building.

Mascoutah, Mo., is to have electric lights. A company with a capital stock of $5,000 has been organized and the stock all subscribed.

Providence, R. I.—The post office is to be lighted with electricity. The Narragansett Electric Lighting Company is to furnish the power.

Blandinsville, Ill., has granted an electric light franchise to White Bros. and Risser, and 150 lights have been contracted for by the merchants.

The Bloomington (Ind.) Electric Light Company is about to install a 150-h. p. Ball engine, manufactured by the Ball Engine Company, Erie, Pa.

Riverside, Ill.—Ground has been broken in Riverside, a suburb of Chicago, for an electric light plant, and the village will be lighted by electricity by Dec. 1.

Red Oak, Ia.—The Red Oak Electric Light Company has secured the contract for the construction of the new electric light plant to be put in at Shenandoah.

Coldwater and Pontiac, Mich.—Contracts for electric lighting plants for Coldwater and Pontiac have been secured by the Commercial Electric Company, of Detroit.

Fairfield, Me.—The Fairfield and Waterville Electric Light and Railway Company has purchased the mill property and water power formerly owned by E. Totman & Sons.

Gallipolis, O.—The City Council has granted the Gallipolis Electric Light Company a franchise to erect poles and string wires. Eight months has been given it to complete the work.

Peabody, Mass.—At a special meeting recently held the town voted to establish a town electric plant. A committee of five was appointed to investigate and report as to further action.

Little Falls, N. Y.—A special election was recently called to decide on the question of empowering the board of trustees to expend a sum not exceeding $10,000 per year for electric lighting.

The Crown Electric Company, of Chicago, has been organized with a capital stock of $10,000, to manufacture and sell electric curative appliances. The incorporators are Robert Greer, John Greer and Annie Greer.

Livingston, Mont.—The Livingston Electric Light Company has closed a contract with the Northern Pacific Railroad to furnish 150 incandescent and three arc lights. It is expected that the work will be completed by Sept. 15.

Charleston, S. C.—A permit has been granted to the Charleston Light and Power Company for the erection of a brick building at the corner of Concord and March streets for new electric works. The estimated cost of the building is $25,000.

Lansing, Kan.—The work of putting in an electric light plant in the State penitentiary at Lansing has been commenced. When the work is completed there will be an arc light at each tower, at

the front entrance of the prison and in the dining-room, also a light in each cell.

Park City, Utah.—The board of directors of the Park City Light, Heat and Power Company have let a contract to Mr. R. M. Jones, general agent of the Edison company, for duplicating their plant.

Farmington, Mo.—The work of placing the plant for the electric lights was begun last week. The town has given a 20 years' franchise to the Eau Claire National Electric Company for lighting the streets of Farmington, There will be 20 lights furnished at a cost of $600 a year.

Leavenworth, Kan.—The mills of Messrs. Rush & Sprague and Kelly & Lysle will each be lighted by an isolated plant. Superintendent Walker of the Merchants' Electric Light Company of that place has been awarded the contract, and work on the plant has already commenced.

Brooklyn, N. Y.—Plymouth Church building has been equipped throughout with electric lights, an immense chandelier of 60 lamps has been placed in the main auditorium, and 65 other lights are distributed at various points about the room. The other parts of the building are lighted by 160 lights of 16 c. p. each.

Columbus, O.—The State House is to be lighted by electricity and the wiring for the system is about finished. Gas will be entirely displaced. All the offices, the Senate Chamber and hall of the House of Representatives will be lighted with incandescent lamps, while arc lights will be used in the rotunda, four of these being used, one in each of the archway entrances.

Messrs. E. G. Barnard & Co., of Troy, N. Y., have made the following sales: A 300-light plant for a knitting mill, Troy, N. Y.; 100-light plant for a silk mill, Amsterdam, N. Y.; 50-light plant for a broom factory, and one of the same size for a marble works at Watertown, N. Y.; 100-light plant in the knitting mill at Northville, N. Y.; a 50-light hotel plant at Albany, and several other installations. The company has placed a watchman's time detector at St. Johnsville and has taken the annual contract for electric light supplies at the Watervliet arsenal.

THE ELECTRIC RAILWAY.

The Schuylkill Electric Railway Company, of Pottsville, Pa., pays 12 per cent.

Montgomery, Ala.—It is reported that Montgomery is to substitute electricity for mule power on her street railways.

The Shenango Valley Electric Street Railway, connecting the towns of Sharon and Sharpsville, is to be completed, so the directors of the concern decided at a recent meeting.

Dubuque, Ia.—The Dubuque Street Railway Company received last week a new engine for its electric plant. It is a Sioux City Corliss of 250 h. p., with a fly wheel 15 feet in diameter.

Jamestown, N. Y.—Tracks for the electric cars have been laid as far as Falconer, and cars will be running in a short time from Jamestown to Falconer Junction, the terminus of the road.

The Dubois Traction Passenger Railway Company, Dubois, Pa., is installing a 100-h. p. engine, manufactured by the Ball Engine Company, and sold by Dravo & Black, Pittsburgh.

Fishkill Landing, N. Y.—The board of trustees of Fishkill Landing has granted a franchise to the Citizens' Electric Railway Company to construct and maintain an electric railway from the eastern boundary of the village to the river.

Danvers, Mass.—At a special town meeting to take a vote of taxpayers on the question of allowing the Naumkeag Street Railroad Company to substitute electricity for horses as a motive power, the vote was overwhelmingly in favor of electricity, and the company will at once proceed to introduce the latter.

Memphis, Tenn.—The first shipment of the electrical machinery for the Citizens' Railway, consisting of one generator and six motors, has been received. The power house on Davies avenue and Broadway street is nearly ready for machinery. In the meantime one of the existing street car lines will use power furnished by the Brush Electric Light and Power Company.

Pittsburgh, Pa.—The Second Avenue Electric Railway Company has begun the erection of a new power house beside its present one in Soho. It is the intention of the company to have two engines of 200 h. p. each, connected directly to three dynamos of the same capacity. In addition to these power generators there will be a number of lighting dynamos. The company is contemplating the extension of the road to Homestead.

Seattle, Wash.—The route of the new Seattle & White River Valley Electric Railway, though not yet definitely located, will probably start at South Park and run on the east side of the river to Van Asselts, then crossing the river, on the west side to Orillia, where the road will again cross to the east side and continue to White River and Kent. At the latter place the line will again cross the river to the west side, continuing through the centre of the valley, with branches to Piccadilly and Slaughter.

Easton, Pa.—A charter has been granted to the Weygadt Mountain Railway Company for the construction of an electric road around Weygadt Mountain, a pleasure resort near Easton. The road will be two miles long, and the capital stock of the company is $30,000. The officers of the company are: President, J. Marshall Young, of Easton; secretary and treasurer, D. W. Nevin, of Easton; directors, Major D. R. B. Nevin, of Philadelphia; Horace E. Hand, of Scranton, and Frank L. Wilson and George B. Nevin, also of Easton.

The McKeesport and Reynoldton Electric Railway Company, of McKeesport, Pa., expects to have everything connected with its line in readiness for operation on the 1st of October. The work of track laying is being rapidly pushed toward completion and the generators and motors have arrived on the ground. The line will traverse the principal business streets of the lively city and will also tap every accessible portion of the suburb of Reynoldton. The Thomson-Houston system is the one adopted for the work.

Albany, N. Y.—At a late meeting of the Greenbush trustees the street committee, to which had been referred the application of the Albany Railway Company for permission to construct and operate an electric railway on Broadway, submitted to the board an ordinance containing specifications to be submitted to the Albany Railway Company. In case these are accepted by the railway company it will be necessary for the latter to obtain the consent of a majority of the property owners along Broadway before constructing the line.

LEGAL NOTES.

The Consolidated Electric Light and Power Company, of Kansas City, Mo., has begun suit against the city of Rosedale for what is due the company for lights supplied to that city up to Nov. 10, 1890.

Baltimore, Md.—Judge Harlan has overruled the application of the Union Railway Company for a preliminary injunction against the North Avenue Electric Company to prevent that company from laying rails "within or without the Union Company's tracks."

Harrisburg, Pa.—Trouble has arisen over the attempt of the electric street car company to connect the tracks which it already has in two parts of the city by a new line. The company has not succeeded in obtaining the consent of the City Council for the new track and recently started in to lay the new road without the permission of the city. Several arrests were made, and fines imposed for the alleged breach of contract.

Non-Delivery of a Telegram.—According to the decision of the Supreme Court of Iowa, in the case of Garrett vs. Western Union Telegraph Company, reported in the *Railway and Corporation Law Journal*, the statement printed on a telegraph blank that the sender agrees that he will not claim damages for errors or delays, or for non-delivery of the message, does not exonerate the company from liability for failing to send the message, nor will such statement affect the company's liability for non-delivery where it is clearly proved that the message was not delivered, and there is nothing to show any effort to deliver it. In the case before the court it appeared that a dealer in cattle living in Iowa wired his Chicago correspondent, "Send me market, Kansas City, to-morrow and next day," and that he had previously sent and received a great many messages from that office. The court held that it was a question for the jury whether the message charged the company with notice that the sender intended to act upon the result of it in buying or selling cattle at Kansas City. It having been shown by the evidence that the sender of the message had an arrangement with his correspondent to the effect that if there was no change in the market the correspondent would not answer his telegram, and that on receiving no answer to the telegram the sender bought cattle at the last price that had been sent him, but that he could have ascertained the market price by other means, the court held that the question of his right to recover the damages incurred through his purchase of cattle should be submitted to the jury.

PERSONAL NOTES.

Mr. G. Murray Griffith, of the firm of W. S. Griffith & Co., of Philadelphia, Pa., died at that place on the 28th of August.

Mr. George M. Angier, who for the past year has been associated with the Great Western Electrical Supply Company, of Chicago, has accepted the position of assistant manager of the Knapp Electric Works of that city.

Industrial and Trade Notes.

The Crocker-Wheeler Electric Motor Company, New York, has a large amount of business on hand. It has just furnished a ⅓ h. p. motor for the new Chilian cruiser now being fitted out in England.

The Ball Engine Company, of Erie, Pa., has just completed extensive additions to its plant, largely increasing its capacity. The company has also put in many tools of the latest design, which gives it excellent facilities for getting out special work.

The Improved Fishkill Corliss Engine with Citie's releasing valve gear, noiseless dash pots and other improvements, is said to be meeting with great success. The manufacturer, the Fishkill Landing Machine Company, Fishkill-on-the-Hudson, N. Y., is very busy.

The International Okonite Company (Limited), New York and London, finds a steady call for its Okonite insulated wires and cables. The company is pushing a new underground cable which will doubtless be quite popular, as their other well known goods have been.

Testing Instruments.—The standard electrical testing instruments made by the Weston Electrical Instrument Company, Newark, N. J., are used by nearly every large company engaged in the manufacture and sale of electrical machinery. The manufacturers find business very satisfactory.

Mr. W. L. Fairchild, formerly of the Electric Engineering and Supply Company, Syracuse, N. Y., is now connected with the Syracuse office of the Thomson-Houston Electric Company, and will be pleased to hear from old friends on electrical matters, pertaining either to apparatus or general supplies.

Mr. Thomas H. Fearey, formerly in charge of the Louisville office of the Central Thomson-Houston Company, has been given charge of the railway business in New York State, under the Boston office of the Thomson-Houston Electric Company. His office is in the Kirk Building, Syracuse, N. Y., where the lighting department has been established for some time.

General Machine and Electrical Supplies.—Anything in the line of machinists', general manufacturing and electrical supplies of the best quality can be found in the busy establishment of H. A. Rogers, 19 John street, New York. Members of the electrical fraternity are frequent visitors and find their wants supplied most satisfactorily. Mr. Rogers does an enormous business annually in the famous Moncrieffe Scotch gauge glasses, for which he is the sole United States agent.

The Abendroth & Root Manufacturing Company, 28 Cliff street, New York, is busy filling orders for its latest form of Root boiler, which has acquired a reputation second to none, for safety, reliability and efficiency. It is meeting with great success for central station work and we may be permitted to add deservedly so. The manufacturers will be pleased to furnish our readers with an elegantly illustrated descriptive catalogue of this boiler upon application.

The Ries Electric Specialty Company, of Baltimore, Md., has recently secured the handsome and commodious building on the northeast corner of Baltimore and Eutaw streets, directly opposite the Eutaw House, and has just fitted it up with the necessary machinery and appliances for manufacturing some of its electrical specialties. One of the first of the surprises this company has in store for its electrical friends has been in course of active preparation for some time past and will shortly be introduced to the trade and the public at large.

A Self-Oiling Trolley Wheel.—Badger Brothers, of West Quincy, Mass., have placed on the market a self-oiling trolley wheel that is attracting considerable attention from street railway superintendents who appreciate the convenience of having a well oiled bearing, as the constant lubrication not only prolongs the life of the wheel, but also largely prevents slipping and jumping on the trolley wire, and does away with the noisy rattle sometimes occasioned by a dry wheel. The oil is fed through wicks to the pin and passes back again to the oil chamber, thus repeatedly using the same oil and rendering further attention unnecessary, except at long intervals.

The Standard Coal and Fuel Company, of Boston, with its new compound, "Kem-Kom," claims to have solved the question of economizing in the matter of fuel. From careful reports made by disinterested parties, the company announces that it has been found that a saving of from 15 to 30 per cent. can be effected by the use of this compound, some even giving it as high as 35 per cent. This is no small item in the cost of running an electric plant as will be seen. Not only is there a great saving in the quantity of fuel but a poorer and much cheaper grade of goods may be used with equally good results. A number of railways and electric companies are now using the compound.

Recent Sales of Railway Materials.—The recent orders and shipments of the Engineering Equipment Company, of New York, the selling agent for Anderson line materials and general electric railway supplies, comprise over 900 trolley wire hangers and pull-offs, 165,500 feet span and guard wire, 565 curve insulators, terminals, line breaks and switches, exclusive of 9,350 ground wire clamps, rail bonds and eye bolts, 370 poles, and other construction supplies. Among recent shipments have been complete trolleys delivered at New York, McKeesport, Schenectady, Scranton, Buffalo, Chicago and Denver, Colo., together with poles, wheels and other parts at Portland, Ore.; Ridgeland, Ill.; Colorado Springs, Butte City, Mont.; Pottsville, Pa.; Long Island City, McKeesport, Connellsville, Buffalo, Augusta, Ga., Dallas, Tex., and other places.

A Treatise on Low Tension Arc Lamps.—The Electric Construction and Supply Company, of 18 Cortlandt street, this city, has just issued a pamphlet of 20 large pages which is much more than an ordinary catalogue; it is, in fact, a complete treatise on the construction, adaptation and use of the arc lamp for low tension service, such for instance as incandescent, power and electric railway circuits. The Ward lamp for low tension circuits which this company is placing before central station managers in this country has come into very extended use in some of the most important installations in the United States and for this reason a complete description of its details and its method of operation such as that given in this pamphlet will be welcomed by those to whose attention the question of this method of lighting has been brought. The detailed description of the lamp is taken up under the following heads: (1) The lamp; (2) The railway lamp; (3) The alternating lamp; (4) The search lamp; (5) The theatrical lamp; and (6) The photo-engraving lamp. Those who doubt the applicability of the arc lamp for any of these purposes will be interested in reading the chapters devoted to the explanations of the Ward lamp and its advantages for these various classes of service. Not the least interesting part of the pamphlet is the illustrations and diagrams of the lamp's connections with circuits of different voltages, from 50 to 500 volts. Three very interesting pages of extracts from the proceedings of the association of Edison Illuminating Companies at the Minneapolis Convention are given to show the tendency of present practice in incandescent lighting stations toward the use of arc lamps on low voltage circuits. Opinions of this kind are given by such authorities as Mr. C. L. Edgar, of Boston, Mr. John I. Beggs, of Chicago, and Mr. Barstow, of Brooklyn. The advantages of the combination of arc and incandescent lighting from one and the same circuit when more generally understood by station managers will lead to even a more extended adoption of the Ward lamp for this profitable service, and the company issuing this pamphlet, of which Mr. R. B. Corey is the general manager, deserves credit for this excellent presentation of the subject.

Business Notice.

The Hine Eliminator Company, 106 Liberty street, New York, report an excellent business during the past month. Among those to whom their "Eliminator" was sent they mention the Pardue Institute of Lafayette, Indiana, for use upon their electric laboratory engine, and the Cedar Rapids (Iowa) Electric Light Company. The very high efficiency their eliminator demonstrated (98.8 per cent.) in the test of steam separators, recently made at Cornell University, puts it far to the front of other like competing machines. The company has published in neat pamphlet form the complete text with diagrams of Prof. R. C. Carpenter's report of the Cornell test, which will be sent to any address. It contains points of interest to engineers, and important information for owners of steam plants contemplating the use of a steam separator or an oil and grease extractor.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED SEPT. 1, 1891.

458,582. Electric Railway System; Walter H. Knight, of New York. Application filed May 11, 1885. The invention consists of a number of generators connected, respectively, to succeeding sections of an electric railway, with a number of electric locomotives on said railway, and means for reducing the current of any generator at the instant when a locomotive is leaving the corresponding section of road. (See illustration.

458,584. Electric Motor Truck; Walter H. Knight, of N. Y. Application filed March 5, 1889. The combination, in an electric locomotive having a motor fulcrumed upon an axle and extending down between the wheels on the outside of the axle with frame bars counterbalancing the motor upon the opposite side of the axle and a compression brake sliding on said frame bars.

458,583. Electric Railway; Walter H. Knight, of New York, N. Y. Application filed March 13, 1886. An electric railway having a slotted conduit inclosing the supply conductor and normally parallel with the railway track, but eccentric thereto at a curve, with a contact device connected to a vehicle on the railway at a point at one side of the axle of the truck and having a movement relative to the vehicle about a vertical axis.

458,585. Telegraphy; David Hunhardt, of Aachen, Germany. Application filed March 26, 1891. An apparatus for telegraphing either with direct currents and earth connections or with alternate currents, consisting of a key or lever, with normal and telegraphic contact points, which are either electrically connected together or separate one from another and adapted to simultaneously actuate or put out of action two electro-magnets, the armature of the one having a short stroke, while the armature of the other has a long stroke.

458,587. Electric Brake; John C. Lincoln, of Rochester, N. Y. Application filed Feb. 24, 1891. The combination, with the electromotor and running gear of an electric car, of a rheostat or variable resistance, means for opening the line circuit, and suitable means for maintaining the direction of the current through the field magnets constant when the motor is used as a generator and for directing the current so generated through the rheostat.

458,603. Fusible Cut-Out; Charles A. Van Nuis, of New Brunswick, N. J., and Jonathan H. Vail, of New York. Application filed Oct. 16, 1890. A fusible cut-out having a drum, a motor therefor, pivoted conducting devices at one end of the drum, normally held forward by fusible wires adapted for connection to an electrical circuit, and a stationary circuit terminal supported near one end of the drum and in the path of the movable conducting devices and in contact with one of them, whereby when one fusible wire burns out the motor turns the drum bringing the next device against the stationary terminal.

458,617. Regulator for Constant Current Dynamos; Ernest P. Clark, of New York, N. Y., Assignor to the Clark Electric Company, of same place. Application filed Oct. 4, 1890. In an automatic regulating device, the combination of a dynamo-electric machine, a ring shaped electro-magnet having consequent poles, and journaled at its centre; a spring to oppose the motion of the ring shaped magnet, a movable part actuated by the ring shaped magnet and a rheostat, said movable part adapted to vary the resistance of said rheostat when moved by the action of the ring shaped magnet moving in a magnetic field. (See illustration.)

458,619. Conduit for Electric Railways; Frederick E. Degenhardt, of Chicago, Ill. Application filed Nov. 21, 1890. In a conduit for street railways, the combination of successive sections of drainage conduits independently secured together at their ends with successive sections of covered conductor carrying boxes or conduits closed on their upper sides and supported within such drainage conduit.

458,620. Electric Trolley or Contact Wheel; Frederick E. Degenhardt, of Chicago, Ill. Application filed Nov. 21, 1890. In a trolley for electric railways, the combination of a central conducting disc with insulation external thereto applied to both sides thereof.

458,625. Electro-Therapeutic Apparatus, William J. Herdman, of Ann Arbor, Mich. Application filed Dec. 27, 1890. In an electrical therapeutic apparatus, a main circuit and a patient's circuit in shunt therewith, two series of resistances and sweep-arms for varying the resistance on the shunt circuit, the consecutive resistances on one of said series varying in a decimal ratio to the consecutive resistances on the other of said series.

458,630. Conduit for Electric Railways; Emil E. Keller, of Chicago, Ill. Application filed Nov. 21, 1890. In a conduit for electric street railways the combination of successive insulated conducting strips not in electrical connection with each other and capable of motion with suitable supports, said supports provided with engaging adjacent ends, so that adjacent ends of the conductor strips will move together.

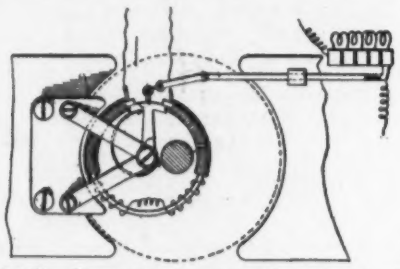
458,646. Electric Motor; Elihu Thomson, of Lynn, Mass. Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Feb. 2, 1887. The combination with the rearward portion of the field magnet pole piece or pieces of the same name, of a supplemental coil applied to such rearward portion and tending to weaken the same.

458,652. Electro-Chemical Transformer; Turner D. Bottome, of Hoosick, N. Y. Application filed Jan. 28, 1890. The invention consists in producing a device consisting of four asymmetrical conductors electrically connected together in such a manner that when alternating currents are passed through the device they are commutated or transformed, so that they are delivered from the said device in one direction only and of a continous character, suitable for energizing electromagnets or for electrolytic operations.

458,653. Incandescent Lamp Cut-Out; Turner D. Bottome, of Hoosick, N. Y. Application filed March 16, 1891. A cut-out for an incandescent electric lamp, consisting of a resilient conducting body supported by the filament and placed between and electrically fastened to one of the terminals of the lamp and adapted to make electrical connection with the other terminal upon rupture of the filament.

458,656. Lightning Arrester; James P. Freeman, of Washington, D. C., Assignor of two thirds to Marvin C. Stone and Philip T. Dodge, of same place. Application filed April 23, 1891. In combination with the main conductors, a spring actuated carrier provided with a series of fusible wires arranged for successive introduction into the circuit by the movement of the carrier, a stop device co-operating with said wires to prevent the movement of the carrier, a ground connection opened and closed by the motion of the carrier, and electro-magnetic stop devices located in the ground line to arrest the motion of the carrier during the continuance of the abnormal current on the ground.

458,665. Electric Railway; Henry A. Seymour, of Washington, D. C., Assignor to the Short Electric Railway Company, of Cleveland, O. Application filed May 5, 1891. In electric railways, a double trackway with a conductor common to the two tracks, and cars provided with trolleys which travel on said conductor with their respective cars on either track.



No. 458,617.—REGULATOR FOR CONSTANT CURRENT DYNAMOS.

458,666. Automatic Cut-Out for Dynamo-Electric Machines; Sidney H. Short, of Cleveland, O., Assignor to the Short Electric Railway Company, of same place. Application filed Oct. 29, 1889. The invention consists in the combination, with the shunt coils of a compound wound dynamo electric machine, of a circuit controlling device for maintaining the shunt coil circuit of the dynamo closed while the machine is generating its normal supply of current, and for automatically opening said circuit on the breaking of the external circuit, and thereby reducing the current generated by the machine. (See illustration.)

458,702. Electric Generator; John C. Henderson, of New York, and Frederick Sargent, of New Rochelle, Assignors to the Edison General Electric Company, of New York. Application filed June 21, 1890. The invention consists of a supporting base built up in two sections, an engine mounted on it, and having a shaft extending from the body of the base at both ends, the movable part of a dynamo on each end of said shaft, and the stationary part of a dynamo mounted on a part of the same base at each end, whereby two dynamos are driven by a single engine with little strain, and whereby the dynamos and the engine shaft are securely held in the same relative position.

458,716. Synchronizing Mechanism for the Second Hands of Clocks; Homer Munson, of Mendota, Ill. Application filed March 3, 1891. In a clock synchronizer, the combination with the second hands and the clock train of a releasing device and a stop whereby the clock train may be released from the escapement and stopped at a predetermined point.

458,718. Carbon Clamp for Electric Arc Lamp; Albert P. Seymour, of Syracuse, N. Y. Application filed Jan. 3, 1889. In a clamp for an electric arc light carbon, a clamp body having on one side a V-shaped extension forming a rigid side of the clamp, in combination with a loose perforated V-shaped clamp block, the heel of which bears loosely on the opposite side of the clamp body and held against lateral displacement thereon by suitable lugs or projections, but free to slide vertically on the body, and a clamp screw or bolt passing loosely through the perforation in the loose clamp block and seated in an extension from the opposite side of the clamp body.

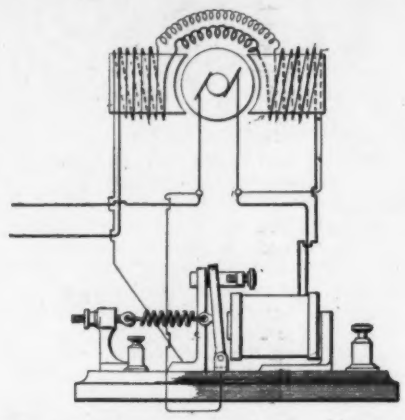
458,719. Duplex-Arc Lamp; Barton B. Ward, of New York. Application filed Dec. 31, 1890. In a double arc lamp, the combination of a switch magnet in the main circuit to the first burning pair of carbons, a switch or circuit controller having back contacts and connections controlling a branch circuit to the derived magnet of the first set, and a retractor operating in opposition to the switch magnet and serving to close the back contact connections and simultaneously open the front contact connections when the arc is interrupted at the first burning pair of carbons.

458,729. Electric Locomotor; Henry F. Shaw, of Boston, and George F. Shaw, of Dedham, Mass., Assignors to Franklin L. Pope, of New York. Application filed Oct. 27, 1888. In an electrically actuated vehicle, the combination of an electric motor, two rollers driven thereby revolving in frictional contact with each other and two friction wheels having flanged peripheries, between which said contact rollers are interposed and against which they respectively press, whereby power is communicated to the axis of said wheels.

458,747. Electric Railway Conduit and Contact Device; Walter H. Knight, of New York, N. Y. Application filed May 10, 1888. The combination, in an electric railway conduit, of a slot rail, a series of transverse supporting yokes, and an insulated conductor within the conduit supported by upward metallic projections from the said yokes.

458,753. Protective Fuse; Hammond V. Hayes, of Cambridge, and Anthony C. White, of Boston, Mass., Assignors to the American Bell Telephone Company, of Boston, Mass. Application filed May 25, 1891. A protective appliance for electric circuits and apparatus, comprising a fuse wire or strip, a tight non-conducting case therefor, means, as indicated, for including the said fuse in an electric circuit, and a detachable stopper for said fuse case adapted to be discharged therefrom on the destruction of the said fuse.

458,755. Electric Meter; Maurice Koechlin, of Belfort, France. Application filed Oct. 16, 1890. An electric meter comprising a Wheatstone bridge, one branch of which includes the circuit, the current on which is to be measured, and another branch of which includes a variable rheostat, combined with an electromotive device in the galvanometric branch of the bridge, and a connection between the movable member thereof and said rheostat, whereby whenever the equilibrium is disturbed the consequent movement of said member alters the resistance of said rheostat until equilibrium is restored and the position of said member becomes an indication of the current to be measured.



No. 458,666.—AUTOMATIC CUT-OUT FOR DYNAMO-ELECTRIC MACHINES.

458,778. Electric Subway; John C. Reilly, of Brooklyn, N. Y. Application filed May 19, 1891. A duct or passage for the reception of underground wires, in combination with a removable leading-in device placed therein, consisting of a longitudinally slotted duct or passage of comparatively small diameter supported upon the interior wall of the first named duct or passage by a frame or bracket conforming in outline to the interior of said duct.

458,818. Constant Current Dynamo; Ernest P. Clark, of New York, Assignor to the Clark Electric Company, of same place. Application filed Oct. 4, 1890. A dynamo-electric machine having field magnets to produce its field of force, deflecting magnets to deflect the magnetic line and diameter of commutation in the armature, and auxiliary brushes touching its commutator on opposite sides at points on or slightly in advance of normal position of the line of equal potential.

458,844. Electric Railway; Leon O. Dion, of Natick, Mass. Application filed Nov. 24, 1890. In an electric railway system an underground main conductor combined with a series of rigid supports extending upwardly from the points outside of the track and laterally over the track and branch conductors extending from the main conductor along said supports, and provided with vertically movable electrodes or terminals projecting below said supports above the track.

458,852. Electric Comb; John M. Riley, of Newark, N. J., assignor to Margaret A. Riley, of same place. Application filed May 1, 1891. An electrical comb combining therein a series of electrically different plates separated by an electrical non-conductor, a chamber for an excitant, and means for holding said plates and insulators in a voltaic pile.

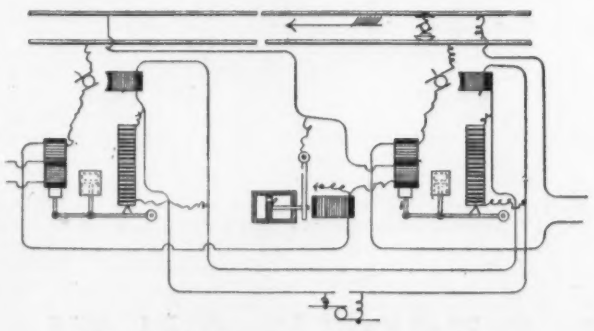
458,856. Armature for Electric Motors or Generators; James F. McLaughlin, of Philadelphia, Pa. Application filed May 26, 1891. An armature for electric motors or generators, comprising a laminated iron body having a circular series of channels near its outer edge and an armature-coil section housed in each channel.

458,859. Method of and Apparatus for Operating Electric Railways by Dynamic Induction; Elias E. Ries, of Baltimore, Md., Assignor to Ries & Henderson, of same place. Application filed May 17, 1887. The method of propelling vehicles by the agency of electricity by causing alternating or intermittent currents on a line or lines of conductors extending along a railway to induce alternating currents in a circuit or circuits feeding one or more propelling electric motors.

458,866. Closed Conduit for Electric Railways; Charles J. Van Depoele, of Chicago, Ill. Application filed Feb. 8, 1887. In electric railways, the combination of a conduit, an electric conductor within the conduit, and a conductor exterior thereto, magnetically controlled circuit closing devices between said conductors, and a magnet for actuating the circuit-closing devices.

458,867. System of Electric Railway Conductors; Charles J. Van Depoele, of Lynn, Mass. Application filed July 19, 1889. In a system of conductors for electric railways, the combination, with an exposed working conductor or conductors, of a conductor insulated from the primary or working conductor, said secondary conductor or conductors forming closed circuits in inductive relation to the working conductors, and grounded connections extending from said secondary circuit or circuits.

458,869. Circuit Controller for Electro-Magnetic Engines; Charles J. Van Depoele, of Lynn, Mass. Application filed Feb. 3, 1891. An electro-magnetic reciprocating engine comprising a central coil and short sectional auxiliary coils at each end thereof, a magnetic plunger adapted to be reciprocated within the coils, and means for constantly energizing the central coil and for alternately placing the set of end coils in circuit there with.



No. 458,582.—ELECTRIC RAILWAY SYSTEM.

458,870. System of Supplying Current to Reciprocating Electric Engines; Charles J. Van Depoele, of Lynn, Mass. Application filed Feb. 26, 1891. A system of supplying currents to reciprocating electric engines, comprising an electric engine having sets of coils energized by currents of different character, a source of continuous current and circuit connections therefrom to the engine, and means in the vicinity of the engine for dividing said continuous current into alternating currents and intermittent or pulsating currents of continuous direction and supplying the same to the different sets of coils in the engine.

458,871. Telpher System; Charles J. Van Depoele, of Lynn, Mass. Application filed Feb. 28, 1891. In an electric railway system, a vehicle or vehicles, a motor upon said vehicle or vehicles, a system of electro-magnetic brakes upon said vehicle, a circuit supplying current to the said motor, insulated sections of conductor connected to the main circuit, and means carried by the vehicle completing the circuit between the insulated sections and the brake circuit, supplying the current to the brake-circuit automatically from the said insulated sections of the conductor.

458,872. Electro-Magnetic Reciprocating Engine; Charles J. Van Depoele, of Lynn, Mass. Application filed March 19, 1891. An electromagnetic reciprocating engine having a plurality of coils, an iron envelope surrounding said coils, and a magnetic shield or shields interposed between a portion of said coils and the surrounding envelope. (See illustration.)

458,873. Combined Electric Engine and Pump; Charles J. Van Depoele, of Lynn, Mass. Application filed March 27, 1891. An electric pumping engine comprising a diamagnetic pump cylinder, a tubular piston therefor of magnetic material and through which the liquid acted upon passes, a motor coil or coils upon the exterior of the pump cylinder for acting upon and imparting movement to the piston, and means for supplying current to the coil or coils.

458,874. Reciprocating Electric Engine; Charles J. Van Depoele, of Lynn, Mass. Application filed April 7, 1891. A reciprocating electric engine having one motor coil energized by an intermittent continuous current, another coil energized by alternating currents having a defined rise and fall, an iron envelope enclosing both coils and magnetized by the intermittent continuous current, and an iron plunger placed under the influence of both coils.

458,876. Electric Arc Lamp; Barton Brewer Ward, of New York, N. Y., Assignor to the Scott Electrical Manufacturing Company, of New Jersey. Application filed Jan. 30, 1890. The invention relates to improvements in electric focusing arc lamps adapted to be used in conjunction with a parabolic reflector of a search light; and the objects of the improvements are, first to provide an automatic focusing light in which there will be uniformity in the feed of the carbons at all angular positions from below a horizontal to a vertical position, and second, to reduce the friction of the rods carrying the carbons.

458,879. Electric Switch; Adolph Wissler, of St. Louis, Mo. Application filed June 22, 1891. The object of the invention is to so construct a switch that the circuit can be closed or opened instantaneously and also embody such a construction that the circuit is always completely closed or opened.

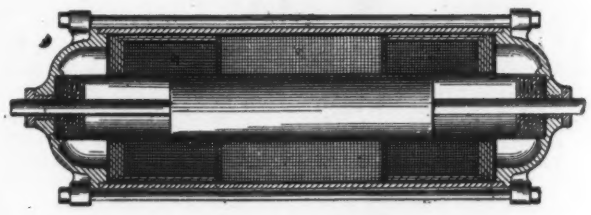
458,880. Casing for Electric Switches; Adolph Wissler, of St. Louis, Mo. Application filed June 22, 1891. As a new article of manufacture, a flush casing for electric switches, consisting of a shell, provided with externally projecting perforated ears situated diametrically opposite each other, with V-shaped external projections, likewise situated, with U-shaped recesses, and with a peripheral flange, and a lid, adapted to be secured to said shell or casing.

458,931. Electric Railway; Walter Cook Wright, of Philadelphia, Pa. Application filed Nov. 25, 1889. In an electric railway conduit, the combination, with the successive conducting trackway sections separated from each other at the conduit joints, of trackway sections of insulating material bridging the space between the said conducting sections.

458,932. Electric Railway; Walter Cook Wright, of Philadelphia, Pa. Application filed Nov. 29, 1889. In an electric railway the combination, with a contact roller carriage, of an arm for supporting the same, springs for sustaining said arm, and an operating lever and intermediate connections for raising said springs and with them the arm and contact roller carriage.

458,947. Annunciator; William C. Dillman, of Brooklyn, N. Y., assignor to Owen Walsh, of New York. Application filed May 6, 1891. An annunciator for speaking-tubes, comprising a swinging leaf supported beneath the mouth of a tube and adapted to close the latter, said leaf being connected with one pole of a battery, a contact bar arranged in the rear of the leaf, a bent arm secured to the leaf and adapted to swing beneath the contact bar, a contact block pivoted to the lower end of the bent arm and adapted to strike the contact bar, and an electric bell included in the circuit.

458,953. Electric Comb; John M. Riley, of Kearney, N. J., Assignor to Margaret A. Riley, of same place. Application filed June 22, 1891. The improved electric comb herein described, combining with a slotted tube furnishing rigid abutments at its opposite ends, a series of insulated and alternating plates forming a voltaic pile, held rigidly within said tube by said abutments.



No. 458,872.—ELECTRO-MAGNETIC RECIPROCATING ENGINE.

458,954. System of Reciprocating Electric Engines; Charles J. Van Depoele, of Lynn, Mass. Application filed Sept. 19, 1890. In a system of reciprocating electric engines, the combination of a stationary electro-magnetic system in circuit with a source of continuous current, an electro-magnetic plunger adapted to move axially therethrough, and a circuit connected with and supplying to the energizing coils of said plunger currents of alternating direction, having a defined rise and fall.

458,956. Controlling Dynamo-Electric Machines for Electric Railways; Sidney H. Short, of Cleveland, O., Assignor to the Short Electric Railway Company, of same place. Application filed April 30, 1890. The combination, with a prime motor and a dynamo-electric generator, of a governor for normal working and a controller comprising an electrically operated appliance adjusted to respond to predetermined abnormally heavy currents and connected with current reducing means.

458,961. Testing-Switch for Electric Circuits; Rudolph C. Smith, of Yonkers, N. Y., Assignor, by mesne assignments, to the National Company, of Illinois. Application filed Dec. 10, 1890. The combination with the electric motor in a main circuit conductor, and the stopping, starting and reversing switch of an elevator, of a grounded circuit, including electric signal, and means for connecting said signal circuit with the main circuit on the shifting of the switch.

458,964. Cleat for Electric Wires; Henry Price Ball, of Brooklyn, N. Y. Application filed April 17, 1891. A three-wire cleat in the sections capable of being screwed together by means of screws passing through the hole in one section, and through the hole in the other section into the place where they are to be fastened, the cleat holding the wires between the inclined planes, which present surfaces between which the wires are clamped.

458,976. Electric Motor; Norton P. Otis and Rudolph C. Smith, of Yonkers, said Smith Assignor to the Otis Brothers & Company, of New York. Application filed July 31, 1890. The method of starting and operating electric motor, which consists in passing the current through all the coils of the armature to render them effective on starting, and subsequently short-circuiting a portion of the coils to render the current passing through them ineffective when the motor is under normal speed.

458,977. Safety Device for Electric Elevators; Norton P. Otis and Rudolph C. Smith, of Yonkers, N. Y., Assignors by mesne assignments to the National Company, of Illinois. Application filed Dec. 31, 1890. In an elevator a traveling cage or platform, a stationary series electromotor having the various field magnet coils connected to the separate terminals, terminals for the main circuit, a switch arranged to break or shift the circuits to arrest, reverse and vary the power of the engine, and appliances between the switch and the cage whereby the operator can shift the switch to arrest, reverse and vary the speed of the engine and cage.

458,987. Electric Arc Lamp; William Arthur Turbayne, of Toronto, Canada. Application filed April 14, 1891. An electric arc lamp, having main and shunt magnets or solenoids, a lever pivoted intermediate of its extremities and connected at its opposite ends with the armatures or cores of the respective magnets, and a ring cluch for the carbon rod provided with lateral arms extending in opposite directions, one arm carrying a roller or other anti-friction device bearing on the said lever and the other arm carrying an adjusting screw, the end of which bears also upon said lever.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.